plating

JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

OCTOBER · 1959

PLATING MAGAZINE

AMERICAN ELECTROPLATERS' SOCIETY

IN THIS ISSUE

Critical Examination of the Ferrocyanide Determination of Cadmium

Outline of the Chemistry Involved in the Process of Catalytic Nickel Deposition from Aqueous Solution

Use of Triethanolamine in Cadmium Plating Solutions

Filtration of Electroplating Solutions

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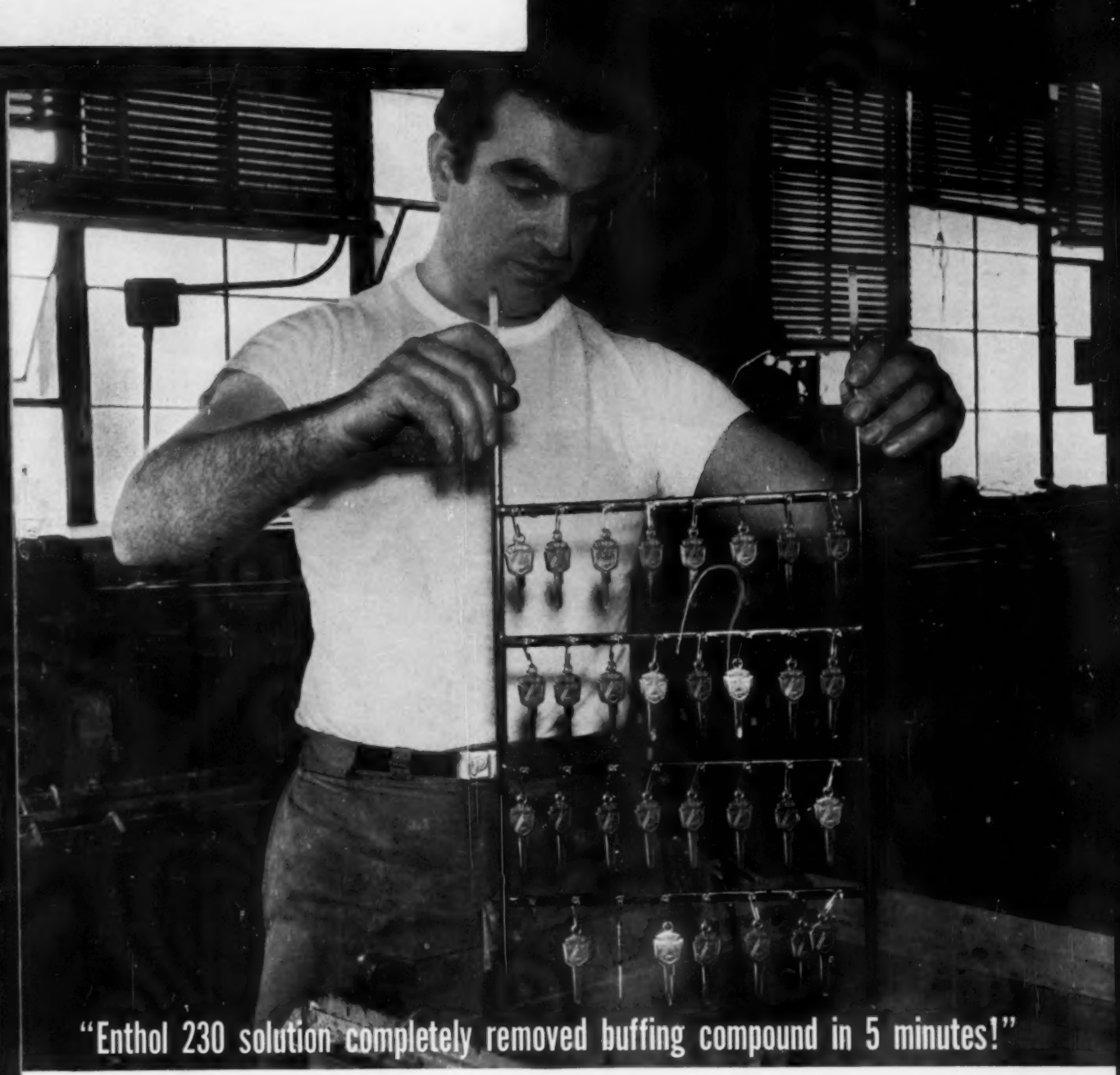

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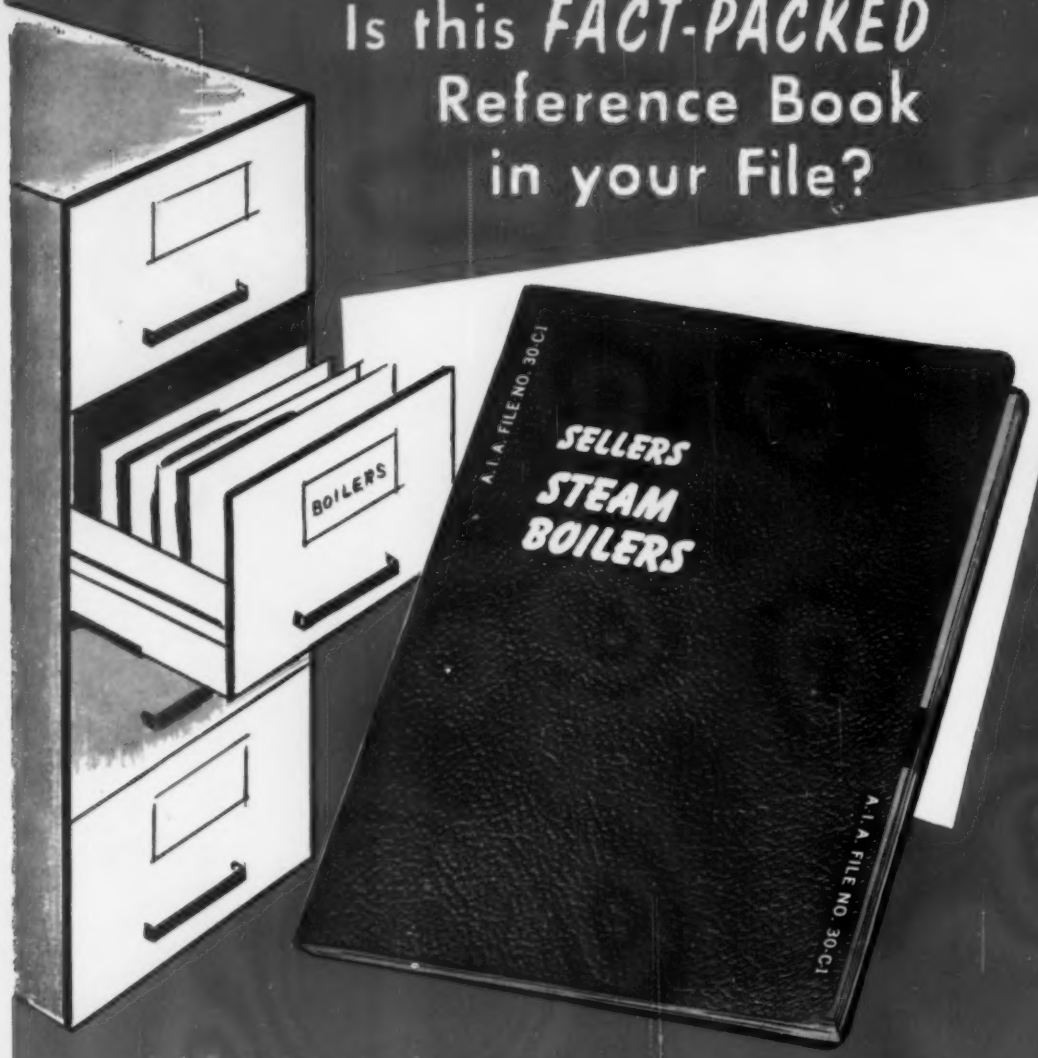

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- Overcoming Building Vacuum and Chimney Back Draft
- Easy Accessibility
- Simple Design, Low Cost Maintenance
- Low Cost Installation
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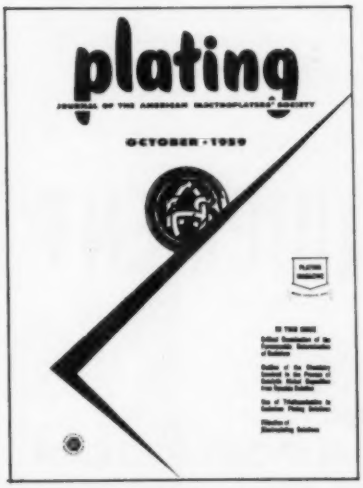

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JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

OCTOBER 1959 — Vol. 46, No. 10

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Published by the American Electroplaters' Society, Incorporated, 445 Broad Street, Newark 2, N. J. Phone: HUmboldt 2-3400. Yearly subscription for Members $2.00. Nonmembers U.S. and Canada $5.00. 65c a copy. Foreign, $8.00 a year, $1.00 a copy. Non-member back issues, Six months or older $1.00 a copy (Golden Jubilee Issue, $2.00 a copy).

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PLATING is indexed in Applied Science and Technology Index and abstracted regularly in Chemical Abstracts, Metals Review, Metallurgical Abstracts, Engineering Index, Technical Data Digest, and Bulletin Analytique.

Statements of fact and of opinion given in articles and papers in PLATING are those of the contributors. The American Electroplaters' Society assumes no responsibility for them.

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EDITORIAL

FORMULA FOR SUCCESS

A STANDARD HUMAN INTEREST type of newspaper story is the interview of the famous person upon the occasion of one of his later birthdays. He is asked to give a word of advice on how to be successful. Unfortunately, no recipe for success has appeared which is effective for any large fraction of the populace. A facetious formula which contains a modicum of truth is the one advising: "To be successful one must begin by choosing the right sort of parents." Successful people undoubtedly have inherent characteristics which assist them in developing drive, initiative and stamina. Perhaps even that wonderful gift called common sense is inherited.

There is nothing one can do about his own heredity but that is only part of the true formula for success. Another part is experience. It is often said that there is no substitute for experience. This is an acceptable statement provided it is interpreted in the broadest sense. Thus, education is a way of obtaining experience because it is basically the organized presentation of the experience of other people. In any field as complex as the finishing of metals the chances of success are greatly magnified by education, whether it be obtained in institutions, in Branch educational classes or by home study.

Another way to profit by the experience of others is to read articles written by people who are successful in your field. These are available in the journals published by technical and educational societies. In the AES such articles appear both in PLATING and in the annual TECHNICAL PROCEEDINGS. This brand of experience enables one to keep his own work and procedures up-to-date, the mark of a man who will be successful.

A third way to benefit by the experience of others is to get the information "direct from the horse's mouth." To do this one must not only meet people who are experienced but he must contact them under conditions conducive to fellowship. This combination of the right people, the right occasion and the right spirit of cooperation can be a most valuable source of information. It occurs often at Branch, Regional and National meetings. Some people in the metal finishing industry fail to get the benefit of such contact and are only too ready to blame the Society for their failure to profit by attending its meetings. They do not realize the importance of the word "cooperation" in the above formula. If one goes to a meeting only to extract as much information from others as possible he will be disappointed. If he takes advantage of the opportunity to *exchange* information he will be rewarded.

Following the summer's lull a new exciting season of AES activities has started. Try out the formula: "Education plus the experience of others plus reading the literature plus exchange of ideas in good fellowship equals success."

W. A. Wesley

First Vice President

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ASK to see a copy of our ABC report.

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JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

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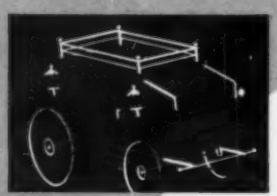
60 years

THROUGHOUT THE PAST 60 YEARS, THE HARSHAW RESEARCH LABORATORIES HAVE PROVIDED MANY DEVELOPMENTS AND IMPROVEMENTS WHICH HAVE SERVED TO PROMOTE THE GROWTH OF THE ELECTROPLATING INDUSTRY. INCLUDED AMONG THESE MANY ADVANCEMENTS ARE THE FOLLOWING OUTSTANDING EXAMPLES:



1927 Rolled depolarized nickel anodes.

1934 NIBRITE...The first commercial bright nickel electroplating process accepted by the automotive industry.

1935 ACID TIN ADDITION AGENT developed.

1936 XXX CAST CARBON ANODES...This special composition carbonized nickel anode was developed for use in bright nickel solutions.

1937 METAL FLUOBORATES used commercially for electroplating.

1945 PERFLOW...The first truly leveling, sulfur free nickel deposit.

1946 GRANULAR NICKEL SALTS...fine crystal free flowing single nickel salts of high purity.

1952 PERGLOW...Outstanding bright nickel with excellent leveling.

1953 PERFLOW-PERGLOW DUPLEX Nickel plate with unmatched corrosion resistance.

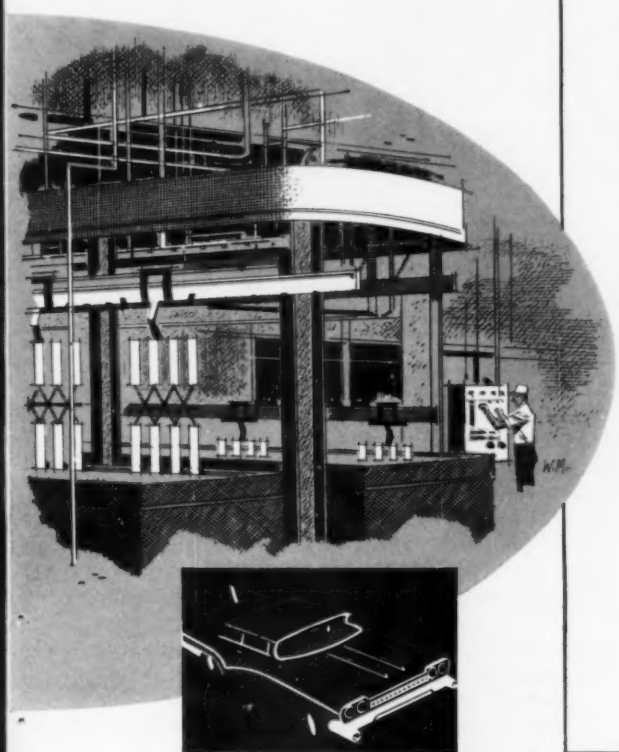
1955 AIR AGITATION...Adaptation for use in Harshaw nickel processes.

1958 CYNOREX COPPER...Exceptionally simplified bright cyanide copper process.

We will continue to offer platers complete service, including full programs of research and development in addition to complete plating processes, anodes, and chemicals

working for Platers

Nickel salts, nickel anodes, and cyanide of potash were Harshaw products produced for the Plating Industry as early as 1899. This modest beginning grew continuously to where our service to Platers includes full programs of research and development, many plating processes, and a complete line of chemicals and anodes. We will be happy to send further information on any of the items listed here—ask us for it.



HARSHAW PLATING PROCESSES:

Acid Tin
Tin Fluoborate
Lead Tin Alloy
Lead Fluoborate
Cadmium Fluoborate
Copper Fluoborate
Nickel Fluoborate
Cynorex Copper (High Speed Cyanide)
Cuprex Copper (Acid)
Perglow Bright Nickel
Nubrite Bright Nickel
Nubrite Bright Nickel (Air Agitated)
Airglow Bright Nickel
Modified XXX Bright Nickel
Perflow Semi-Bright Nickel
Perflow Semi-Bright Nickel (Air Agitated)
Perflow-Perglow Duplex Nickel
Lead — Tin Alloy Plating
Nibrite Barrel Nickel
Super Nibrite Barrel Nickel

CHEMICALS AND ANODES FOR MOST PLATING NEEDS:

Acid Tin Plating Addition Agent
Activated Carbon
Airglow Nickel Plating Addition Agents
Anocaps — Rubber Anode and Hook Protectors
Bags, Anode
Baskets, Anode
Boric Acid
Cadmium Ball Anodes
Cadmium Fluoborate
Cadmium Oxide
Cadmium Plating Addition Agent
Caustic Soda
Caustic Potash
Chromic Acid
Containers, Ball Anode
Copper Ball Anodes — Forged and Cast
Copper Cyanide
Copper Fluoborate
Cynorex Copper Plating Addition Agents
Cuprex Copper Plating Addition Agents
Filter Aid
Fluoboric Acid
Hydrofluoric Acid
Hydrofluesilicic Acid
Hooks, Anode
Lead and Lead Alloy Anodes
Lead Fluoborate
Lead Plating Addition Agents
Nibrite Barrel Nickel Plating Addition Agents
Nickel Acetate
Nickel Anodes — Rolled and Cast
Nickel Anodes — Toll Cast
Nickel Carbonate
Nickel Chloride
Nickel Formate
Nickel Fluoborate
Nickel Salts, Single
Nubrite Nickel Plating Addition Agents
Perflow Nickel Plating Addition Agents
Perglow Nickel Plating Addition Agents
Potassium Cyanide
Potassium Stannate
Rochelle Salts
Silver Cyanide
Sodium Cyanide
Sodium Stannate
Super Nibrite Barrel Nickel Plating Addition Agents
Tin Aluminum Alloy Anodes
Tin Anodes — Ball and Cast
Tin Chloride
Tin Fluoborate
Tin Sulfate
XXX Bright Nickel Plating Addition Agents
Zinc Anodes — Ball, Basket Type and Cast

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AES *on its 50th*

ANNIVERSARY

News about COATINGS FOR METALS

from Metal & Thermit Corporation

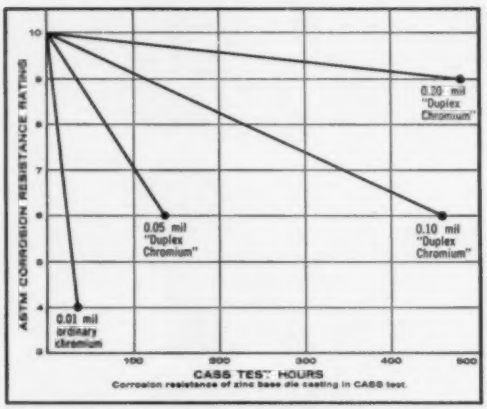
How to get the optimum protection of bright chromium plating

There are three requisites to increasing corrosion protection from chromium plating. (1) The deposit must be sufficiently thick. (2) There should be a crack-free chromium base topped by a special, finely cracked chromium deposit. (3) The plate should be more uniformly distributed over the part, so that recessed areas, too, are assured at least 0.03 mils minimum chromium thickness.

All of these requirements are easily met through UNICHROME SRHS® CHROMIUM plating processes. Work done for the automotive industry, long plagued by corrosion of brightwork in outdoors exposure, provides a good case in point.

AN ANSWER TO OUTDOOR CORROSION

Note the results in the chart at right. In all cases, the thickness of undercoats was kept constant. Only the chromium plate was varied... from ordinary to "Duplex", and progressively thicker. M&T "Duplex Chromium" calls for first using Unichrome Crack-Free Chromium and its ability to throw into recesses and give a more uniform and fracture-free plate. This is followed by another deposit of Unichrome SRHS Chromium, with its *controlled* cracking. With increasing thickness, the protection increased tremendously. Durability as determined by rigorous, accelerated corrosion testing techniques was multiplied as much as *20 times*.

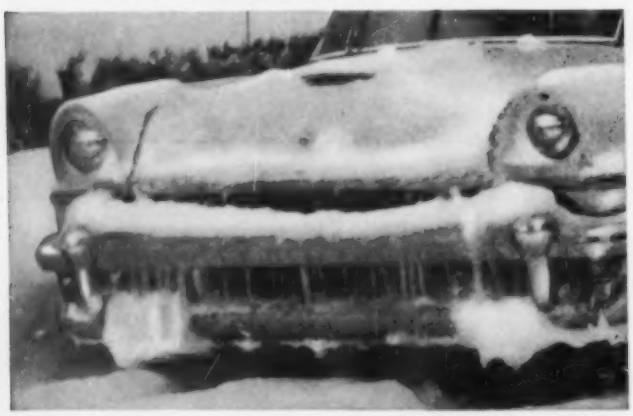


Corrosion resistance of zinc base die casting in CASS test.

Zinc die cast specimens, all plated with 0.75 mil copper and 0.75 mil nickel prior to chromium lasted as shown above in the severe CASS test (Copper accelerated acetic acid salt spray). Ordinary chromium fared poorly. Optimum protection was approached by using Crack-Free Chromium and increasing the deposit thickness.

•

Despite severe service conditions, automotive brightwork can stay bright now, due to the additional corrosion protection that M&T "Duplex Chromium" provides.



WIDELY USEFUL FINISH

While the above case concerns itself specifically with an automotive problem, it indicates what thicker chromium in general, and crack-free chromium in particular can do for other design problems involving corrosion and wear. This plate blocks infiltration of corrosives to underlying metal.

Technical Papers giving full details on the advantages of thicker chromium deposits are available for the asking. Write METAL & THERMIT CORPORATION, Rahway, New Jersey.

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CORPORATION

3,500,000 pounds of plating

processed by this UDYLITE TEMPRON cylinder . . . and it's *still going strong*

This TEMPRON Cylinder has handled more than three and one half million pounds of work without replacement or repair. This impressive performance was recorded at the Detroit plant of Bellevue Plating, a division of National Machine Products Co. There, 24 of these cylinders continue daily to deliver high economy, low maintenance production for the fifth straight year. They are operated regularly under extreme and abrupt temperature changes stubbornly resisting heat, cold, abrasion and chemical action.

In the experience of users everywhere, these rugged TEMPRON Cylinders, an original Udylite design, prove to be a best-possible buy. You, too, can achieve full production with an absolute minimum of shut-downs for maintenance by installing durable Udylite TEMPRON Cylinders in your plant. If you're not already enjoying the benefits of these perennially economic producers you owe it to yourself to investigate their money-making potential. Ask your Udylite man about TEMPRON cylinders or write . . .

Al Betteley of Bellevue Plating says:

"We are thoroughly satisfied with Udylite TEMPRON Cylinders. The only reason that we haven't bought more of them for our present equipment is that we haven't worn out the original ones. You may be sure that we will specify Udylite TEMPRON cylinders on any new equipment of this type."

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detroit 11, michigan • world's largest plating supplier

For a pre-cleaning short-cut to better plating

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS

Now—remove smut, rust and soils with one electrocleaner: Oakite 190

Here is a new reverse-current cleaner that performs two operations at once. (1) It removes the oily soils normally requiring an alkaline cleaner . . . and (2) it removes smut and rust bloom normally requiring additional treatment.

New Oakite 190 performs this double duty because it's a *chelated* detergent. Chelation—which makes metallic salts and oxides soluble in water—handles the removal of smut, heat scale and rust. Powerful alkaline detergency handles the removal of oil films and shop soil. As a bonus, Oakite 190 has high conductivity, rinses well in hot or cold water.

Result: new Oakite 190 insures fewer plating rejects due to inadequate pre-cleaning, *eliminates an entire operating step* in many instances.

For more details about Oakite 190, ask your local Oakite man or write to Oakite Products, Inc., 18 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

50 *1909-1959 years' leadership in industrial cleaning*

SCIENCE

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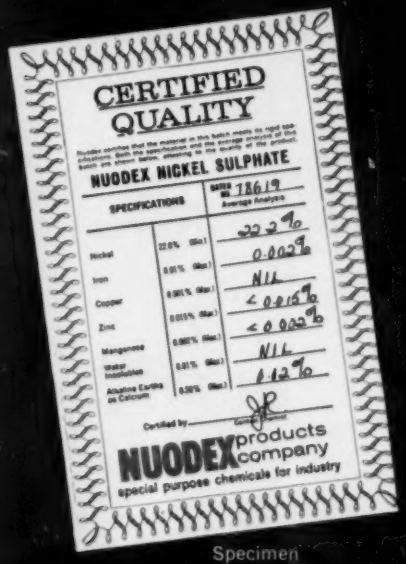
CERTIFIED QUALITY

NUODEX NICKEL SULPHATE

SPECIFICATIONS		BATCH NO. 78619 Average Analysis
Nickel	22.0% (Min.)	22.2%
Iron	0.01% (Max.)	0.002%
Copper	0.001% (Max.)	NIL
Zinc	0.005% (Max.)	< 0.0015%
Manganese	0.002% (Max.)	< 0.002%
Water Insolubles	0.01% (Max.)	NIL
Alkaline Earths as Calcium	0.30% (Max.)	0.12%

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Diversey's new electrocleaning development can boost your output ...and reduce costs

This could be the electrocleaning improvement you've been waiting for. The combination of Diversey No. 15 SOAK CLEANER plus new Diversey No. 35 ELECTROCLEANER means increased production . . . and lower cost per part. You get absolute cleanliness with smut-free, waterbreak-free surfaces. The treatment results in more adherent plate . . . sharply reduced rejects . . . lower costs.

Here's the combination that is getting a new high in results on high-speed production lines:

Diversey No. 15 heavy duty soak cleaner. High speed removal of oily contamination • thorough emulsification • exceptional wetting action.

Diversey No. 35 high conductivity electrocleaner. Maximum conductivity . . . permits full loading of racks • produces waterbreak-free, smut-free surfaces, even in low current density areas.

Maintenance savings, too. Both cleaners deliver a new high in contamination tolerance for long solution life. And their advanced type water softening properties prevent hard precipitates from forming on tanks, reducing maintenance and down-time.

Get the facts now on the new cleaning combination that can give you better plating at less cost. See your Diversey D-Man or write Metal Industries Department, The Diversey Corporation, 1820 Roscoe Street, Chicago 13, Illinois.

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The Interlox line was developed by Northwest's Cleaning Specialists to give you a better, lower cost, easily controlled phosphate base for organic finishes.

Interlox iron phosphate products deposit a high quality, fine grained, dense coating with great speed and dependability.

There is an Interlox product developed to meet your particular need whether spray or immersion type, single or multiple stage. Interlox baths are unusually long lived and require less additions and control.

Northwest's production-tested chemicals and dependable recommendations will save you money. Your Northwest Cleaning Specialist can give you expert advice on any cleaning or phosphatizing problem.

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NORTHWEST CHEMICAL COMPANY

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Seen by visitors on television and plant tours, the V.I.P. is here described by mistress-of-ceremonies on closed circuit telecast to the floor of the metal finishing show.

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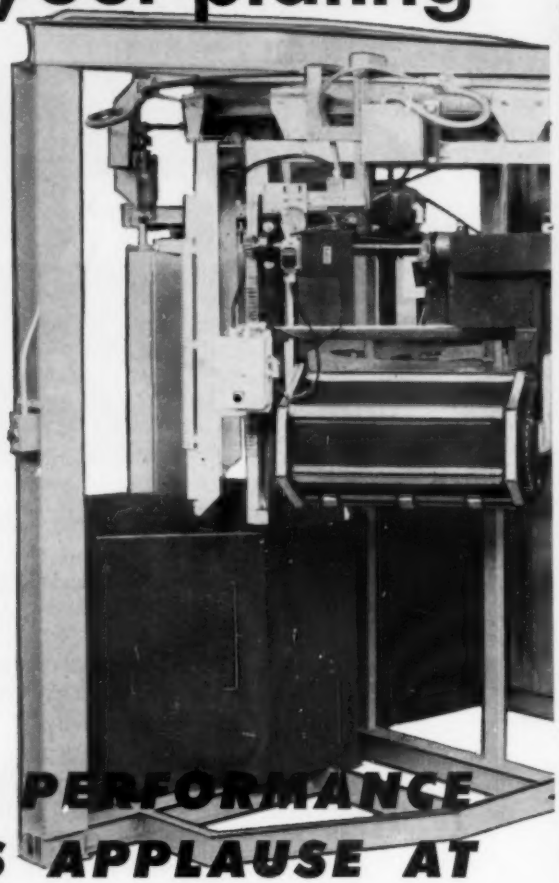

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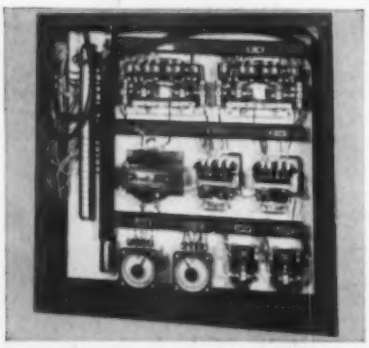
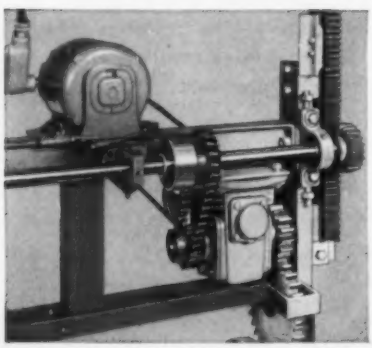
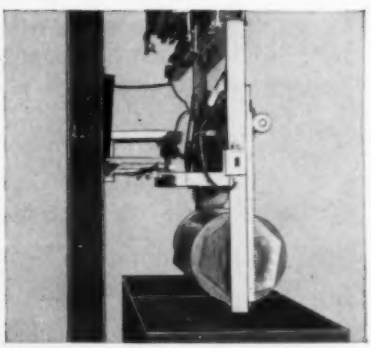


Reversing starters for lift and transfer motors, adjustable timers for delayed dips, down-dwells and drag-outs, and the relays for automatic machine operation are all centered in this single control panel.



Individual power unit for each barrel and carriage assembly provides cylinder rotation in the "down position". When reversed, an over-running clutch grips the shaft to raise the barrel for transfer to next station.



Side view of the V.I.P. carriage unit shows complete accessibility, for simple easy servicing, of all parts, anodes and solutions. The ample clearance around each unit also provides for excellent ventilation of the machine.

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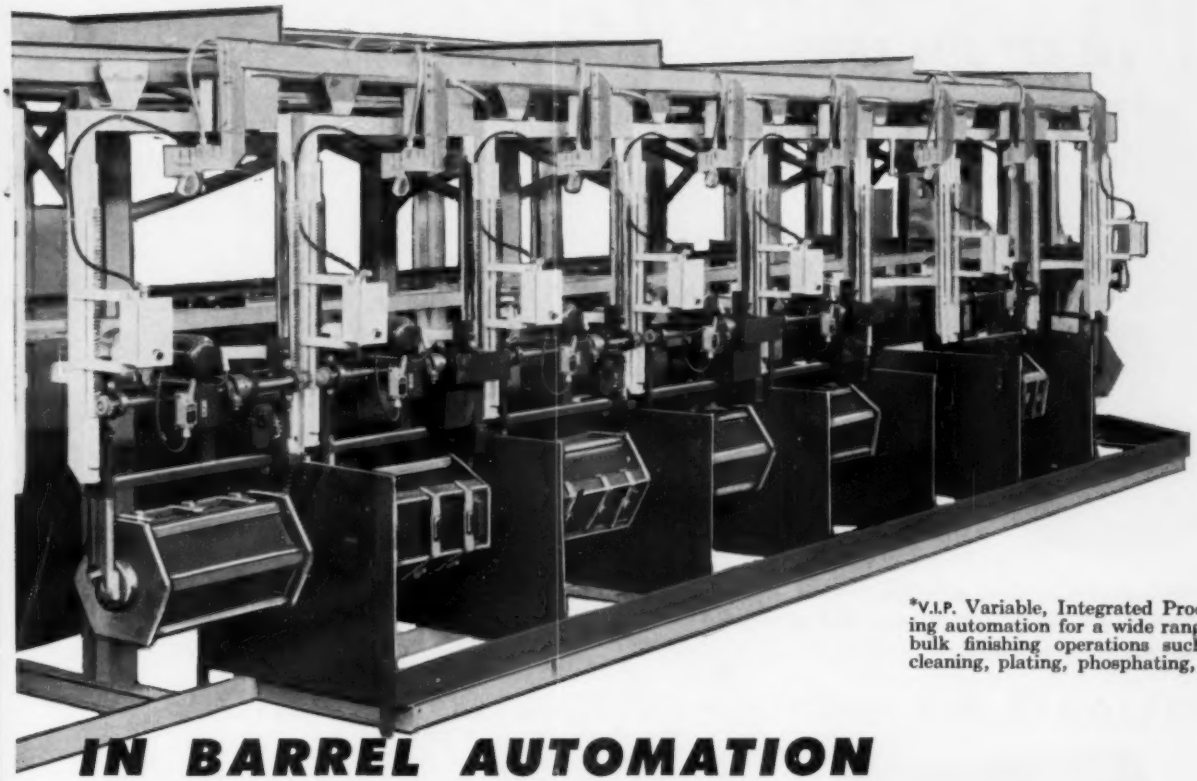

*V.I.P. Variable, Integrated Processing automation for a wide range of bulk finishing operations such as cleaning, plating, phosphating, etc.

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By
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Photostat or microfilm copies of articles in available magazines may be obtained from: Library of Congress, Washington, D. C.; New York Public Library, New York; Engineering Societies' Library, New York, at prevailing rates. In other cases, consult Wilson's Union List of Serials at your nearest public library for other sources of these articles.

109. ALUMINUM

a. *ELECTROCLAD ALUMINUM ON URANIUM.*
John G. Beach and Charles L. Faust.
Journal of the Electrochemical Society, *106*, No. 8, August 1959, pp. 654–659.

110. CHROMIUM

a. *ELECTRODEPOSITION OF CHROMIUM ALLOYS.*
Charles Levy.
Metal Finishing, *57*, No. 8, August 1959, pp. 59–62, 65.

111. CONTROL

a. *ANALYSIS OF SULFURIC ANODIZING SOLUTIONS.*
J. B. Mohler.
Metal Finishing, *57*, No. 8, August 1959 pp. 63–65.

112. FINISHING

a. *THE PROBLEM: FINISH PRINTED CIRCUITS.*
Grinding and Finishing, June 1959, p. 30.

b. *BUFFING AT FORD'S MONROE PLANT.*
M. M. Patterson.
Grinding and Finishing, April 1959, pp. 27–29.

113. INDIUM

a. *GLYCEROL BATHS FOR THE ELECTRODEPOSITION OF MOLTEN INDIUM OR INDIUM-CADMIUM ALLOY.*
A. J. Certa, T. J. Manns, G. L. Schnable and H. S. Segal.
Journal of the Electrochemical Society, *106*, No. 8, August 1959, pp. 690–693.

114. INSTRUMENTATION

a. *SURFACE-FINISH MEASUREMENT ON NONFERROUS MATERIALS.*
Bradley Piper and William P. Callis.
American Machinist, *106* No. 16, August 10, 1959, pp. 105–120.

115. IRON

a. *ELECTROLYTIC IRON POWDER FROM A CAUSTIC SODA SOLUTION.*
J. Adrien LeDuc and Richard E. Loftfield.
Journal of the Electrochemical Society, *106*, No. 8, August 1959, pp. 659–667.

116. MISCELLANEOUS

a. *THE JAPANESE PLATING INDUSTRY TODAY.*
Products Finishing, August 1959, pp. 54–63.

b. *HEALTH LEGISLATION CONCERNING PAINT INGREDIENTS.*
Harold P. Preuss.
Metal Finishing, *57*, No. 8, August 1959, pp. 68–71.

117. NICKEL

a. *PLATING TEAM HOLDS DOWN COST IN TOOLING FOR NOSE CONES.*
G. H. Cook and L. P. Vollmuth.
The Iron Age, *184*, No. 7, August 1959, pp. 83–85.

118. ORGANICS

a. *FORD'S EXPERIENCES WITH WATER-BORNE PAINTS.*
Russel D. Hamilton.
Products Finishing, August 1959, pp. 24–31.

b. *HYBRID PAINTING MACHINE FLOW COATS, SPRAYS.*
Products Finishing, August 1959, pp. 40–44.

119. PREPARATION

a. *ELECTROPLATING ON TITANIUM.*
Nelson Murphy.
Products Finishing, August 1959 pp. 68–72.

120. THEORETICAL

a. *ELECTROMOTIVE FORCE SERIES OF METALS IN FUSED SALTS AND ACTIVITIES OF METAL CHLORIDES IN 1:1 MOLAR KCl-NaCl SOLUTIONS.*
S. N. Flengas and T. R. Ingraham.
Journal of the Electrochemical Society, *106*, No. 8, August 1959, pp. 714–721.

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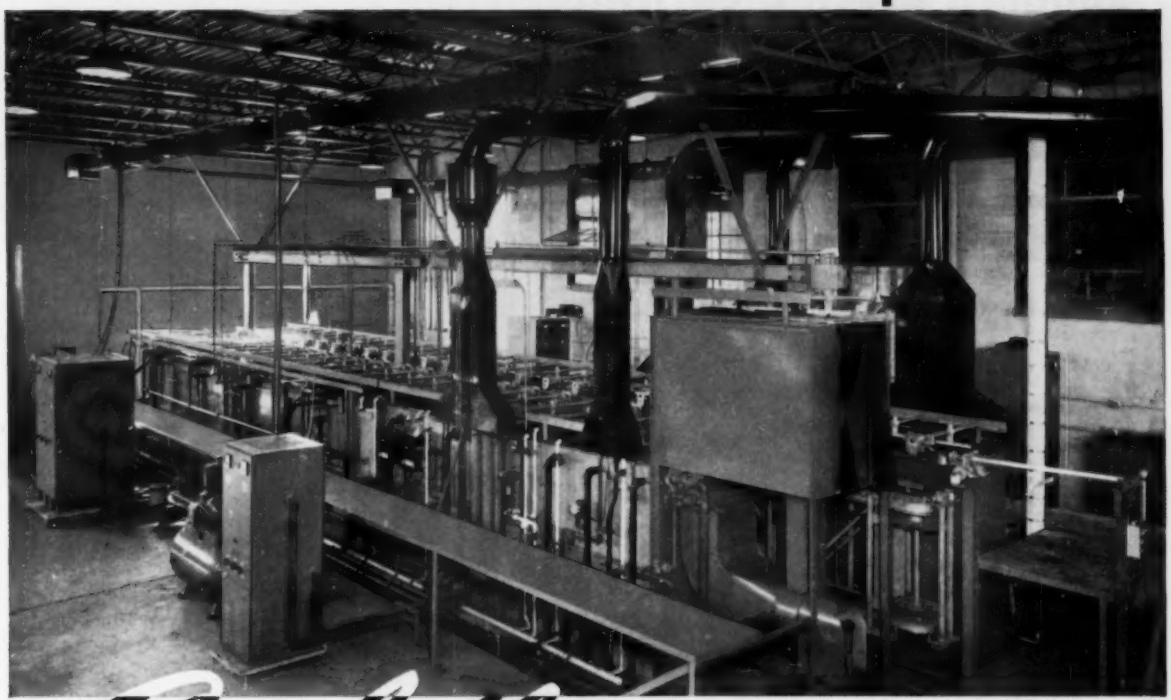

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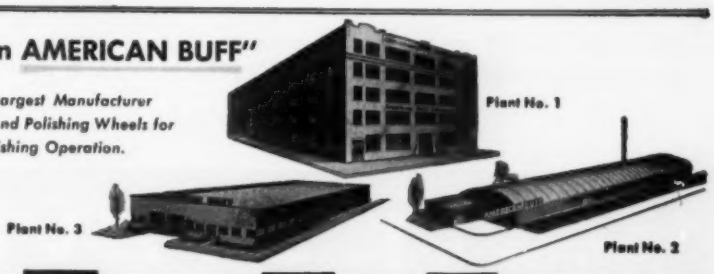

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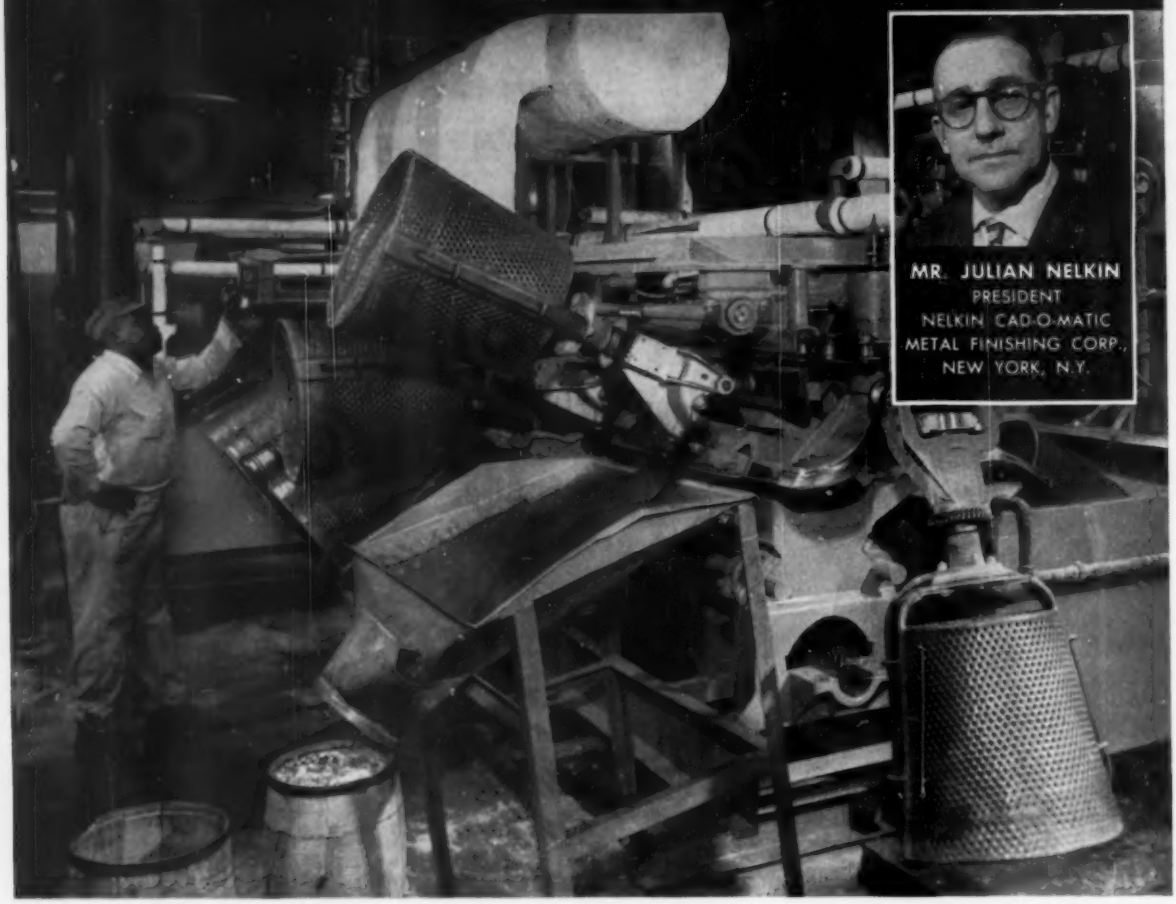

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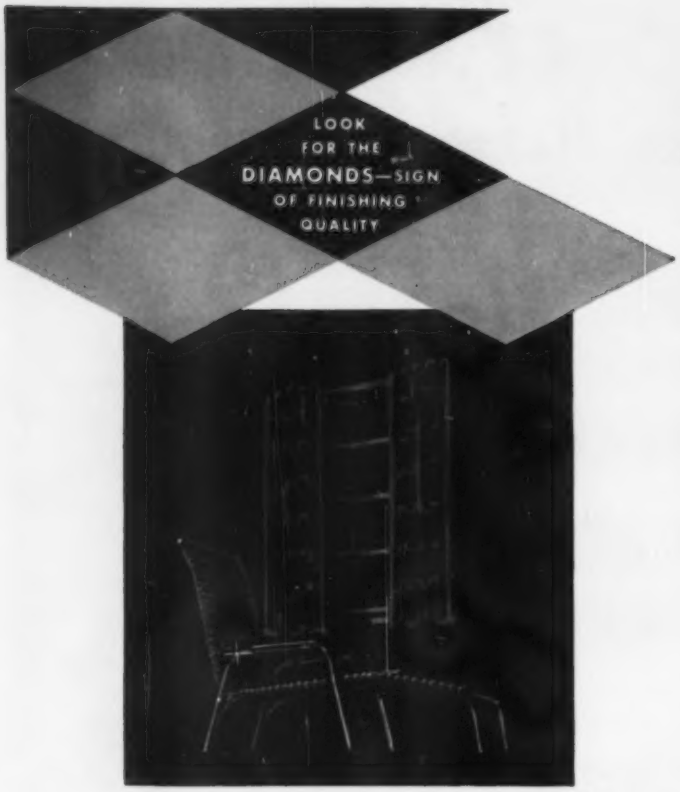

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For complete technical information on IRIDITE Chromate Conversion Coatings or IRILAC Clear Protective Coatings, write for FREE TECHNICAL MANUAL. Or, see the Allied Field Engineer in your area. He's listed under "Plating Supplies" in the yellow pages.

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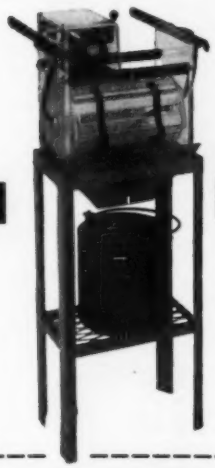

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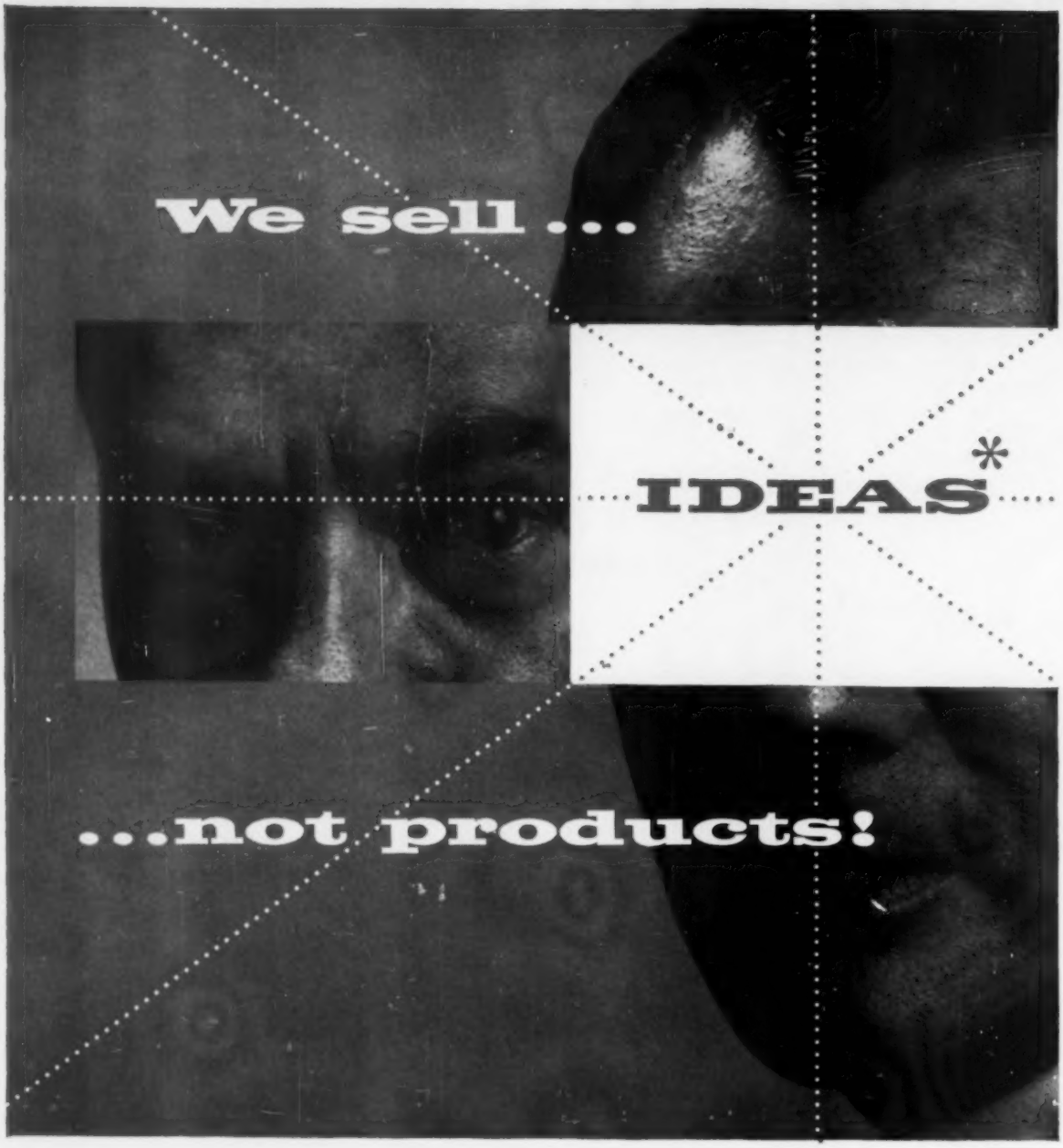

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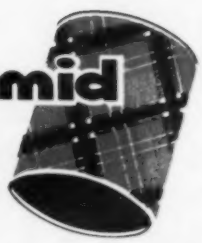

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A CRITICAL EXAMINATION of the FERROCYANIDE DETERMINATION of CADMIUM and RELATED REFERENCES

by HELEN M. ROSENBERGER and CLARENCE J. SHOEMAKER*

The need of small plating establishments for simple analytical procedures which can be performed by unskilled technicians with a minimum of equipment is examined. The volumetric determination of cadmium in plating solutions is the example used and reasons are given for the preference of the EDTA method over the potassium ferrocyanide titration.

STEVENS AND LANCY[1] recently pointed to the need of small plating establishments for simple plating analysis procedures. These methods may lack the ultimate in sensitivity and accuracy but they should provide the needed results in a rapid and simplified manner. The procedures should be adaptable to readily available, inexpensive equipment and unskilled technicians.

Standard volumetric titration methods are best suited to these conditions and for years the method most commonly used for zinc and cadmium has been the potassium ferrocyanide titration. Most of the inexperienced technicians are probably dependent on a reference source for the description of the method and calculation of results. The authors would like to point out the possible pitfalls of indiscriminate use of such references.

In the course of routine analysis of a cadmium plating solution some anomalous results were encountered between two laboratories. The routine procedure involved the precipitation of cadmium as the sulfide, redissolving the precipitate and determining the cadmium content volumetrically by titrating with potassium ferrocyanide using uranyl acetate as an external indicator. This method is essentially that described in the first edition of Langford.[2] The results of laboratory "A" were consistently 4.5 to 4.6 oz Cd/gal whereas laboratory "B" obtained 3.2 to 3.3 oz Cd/gal.

A thorough investigation into the techniques used in the two laboratories finally turned up one point of difference in the procedures. Laboratory "A" with consistently high results, followed the Langford text which recommended standardizing the potassium ferrocyanide against pure zinc metal and converting to the cadmium equivalent by an indicated multiplying factor of 1.79. Laboratory "B" prepared the sample in the same manner but following the preferred analytical technique, standardized the reagent directly against pure cadmium metal.

As a result, we decided to evaluate the methods described in several references that were readily available to us. In the early edition, Langford prepared a solution of potassium ferrocyanide, which, when standardized against pure zinc metal, is equivalent to 0.01 grams of zinc per milliliter. It is stated that this solution is also suitable for titrating cadmium, in which case 1 milliliter is equivalent to 0.0179 g cadmium.

A potassium ferrocyanide solution was prepared and standardized against both zinc and cadmium metal. The standardization was performed by visual titration, as described by Langford, using uranyl acetate as an external indicator. The solution was also titrated potentiometrically using a platinum-calomel electrode system[3, 4, 5] to eliminate any possibility of over shooting the end-point. The results of the standardization are shown in Table I. It is readily seen that two divergent cadmium factors are possible. One factor obtained by direct titration of cadmium and one factor derived by calculation from the zinc equivalency.

In an effort to determine which of these values was the true factor, the freshly standardized reagent was then used to titrate a cadmium plating solution. The cadmium content of the solution was assayed at 3.3 oz Cd/gal by electrolytic deposition and confirmed by a gravimetric method. A 10 milliliter sample of the plating solution was used in all cases and the results are given in Table II.

Using the factor found by direct titration of the reagent against cadmium, the potentiometric results of 3.26 oz Cd/gal are in excellent agreement with the assay value of 3.3 oz Cd/gal. The use of the factor derived by calculation from the zinc equivalency gives a cadmium content of 4.66 oz/gal. Therefore, the true factor was obtained by direct titration of the cadmium metal.

Since the visual titration of cadmium consistently required 4 milliliters less of titrant than the potentiometric titration, it is obvious that a false end-point had been reached. Thus the visual titration, being short of the stoicheiometric end-point, may have appeared to give approximately correct results of 3.7 oz Cd/gal only because the false end-point was compensated for by the high cadmium factor derived from the standardization of the reagent against zinc.

In a later edition, Langford states that the potassium ferrocyanide should be standardized against cadmium and that it is not satisfactory to calculate the equivalency of the solution in terms of a cadmium factor from a zinc standardization. However, in using this reference for the calculation of results, it was noted that for simplicity a conversion factor multiplied by the milliliters of titrant gave the concentration of cadmium in oz/gal (ml of ferrocyanide used x 0.1600 = oz Cd/gal). This conversion factor represents the aliquot of the sample, factor of the titrant and conversion of g/liter to oz/gal. Since the reference is British, the conversion factor represents British gallons rather than U.S. gallons. Therefore, where

TABLE I
STANDARDIZATION OF POTASSIUM FERROCYANIDE REAGENT

Standard Used	Method	Factor Found
Zinc metal	Potentiometric	0.0102 g Zn/ml
Zinc metal	Potentiometric	0.0102 g Zn/ml
Zinc metal	Visual-external ind.	0.0104 g Zn/ml
Cadmium metal	Potentiometric	0.0128 g Cd/ml
Cadmium metal	Potentiometric	0.0128 g Cd/ml
Cadmium metal	Visual-external ind.	* .....
Zinc metal	Calculated to Cd equivalency by Langford 1.79 factor	0.0183 g Cd/ml
Zinc metal	Calculated to Cd equivalency by molecular weight factor of 1.72	0.0174 g Cd/ml

*False end-point was observed. Persistent fading made true end-point difficult for untrained observer.

*Chemical Research and Engineering Department, A. B. Dick Company, Chicago 48, Illinois.

TABLE II
TITRATION OF CADMIUM PLATING SOLUTION
(10 ml sample)

Method	ml $K_4Fe(CN)_6$	Oz Cd/Gal: 0.0128 F Derived from Cd Standardization	Oz Cd/Gal: 0.0183 F Derived by Calculation from Zn Standardization
Potentiometric	19.10	3.27	4.65
Potentiometric	18.95	3.26	4.66
Potentiometric	19.00	3.26	4.66
Visual-external indicator	15.20	2.08	3.73
Visual-external indicator	14.80	2.02	3.62
Visual-external indicator	15.00	2.05	3.66

$$\text{where oz Cd/gal} = \text{ml } K_4Fe(CN)_6 \times F \times \frac{1000}{10} \times 0.134$$

3.26 oz Cd/gal was found, the technician using the Langford calculation would obtain 3.9 oz Cd/gal. This represents an error of 18 per cent. Thus, laboratory "A's" erroneous results of 3.7 oz was actually reported as 4.5 oz/gal, representing a total analysis error of 36 per cent.

Gray[7] cites the same method for cadmium and he standardizes the potassium ferrocyanide against 0.25 grams of cadmium metal. The calculation of results for a 5 ml sample is then shown by the equation:

$$\text{oz Cd/gal} = 6.67 \times \frac{\text{ml } K_4Fe(CN)_6 \text{ for sample}}{\text{ml } K_4Fe(CN)_6 \text{ for standardization}}$$

Thus the 6.67 factor is only valid when a 5 ml sample is used and when the standardization of reagent has been made with exactly 0.25 grams of cadmium metal.

Graham[8] also standardizes against zinc and then calculates the cadmium equivalent. However, a typographical error appears in the cadmium calculation and the equation does not give an oz/gal value although it is so listed.

Blum and Hogaboom[9] recommend standardizing against cadmium and give a concise explanation of the derivation of the calculation. This gives the inexperienced technician a clear incite into the mathematics involved.

The newer method of complexometric titration[1,10] using EDTA (disodium ethylenediamine tetraacetate) is a preferable method for the plant technician. The method utilizes an internal indicator which gives a good, sharp color change at the end-point and may be standardized against zinc and calculated to the cadmium equivalent with accurate results as indicated by the data in Table III. The results of three operators using the EDTA method for the first time on the cadmium plating solution are also shown.

From past experience, we have found that technicians occasionally alter the sample size or readjust the recommended concentration of the titrant to speed up the titration and then neglect to change the calculation to compensate for the change. From the several references cited above, it would seem very worth while if the authors of such references would interpret the derivation of the multiplying factor. Thus when the technician modifies the procedure it will become obvious to him that a calculation change is also required to obtain correct results.

TABLE III
STANDARDIZATION OF EDTA REAGENT

Standard	Weight	ml EDTA	Factor Found
Zinc metal	0.2261 g	35.00	0.0065 g Zn/ml
Zinc metal	0.1578 g	24.30	0.0065 g Zn/ml
Cadmium metal	0.1995 g	17.80	0.0112 g Cd/ml
Cadmium metal	0.2091 g	23.40	0.0112 g Cd/ml

Zinc metal calculated to cadmium equivalent

$$0.0065 \text{ g Zn/ml} \times \frac{\text{M. W. cadmium}}{\text{M. W. zinc}} = 0.0112 \text{ g Cd/ml}$$

Titration of Cadmium Plating Solution (10 ml sample) with EDTA Reagent.

Operator A	22.00	3.30	oz Cd/gal
Operator B	21.90	3.28	oz Cd/gal
Operator C	22.00	3.30	oz Cd/gal

$$\text{where oz Cd/gal} = \text{ml EDTA} \times 0.0112 \times \frac{1000}{10} \times 0.134$$

REFERENCES

[1]Stevens, F., and L. E. Lancy, Plating **45**, 832–4, (August 1958).

[2]Langford, K. E., "Analysis of Electroplating and Related Solutions," 1st. ed., 24–5, 326–7, Draper Limited, Middlesex, England (1951).

[3]Kolthoff, I. M., and N. H. Furman, "Potentiometric Titrations," 324, Wiley, New York (1931)

[4]Lingane, J. J., "Electro Analytical Chemistry," 91, Interscience Publishers, New York (1953).

[5]Kolthoff, I. M., Laitinen, H. A., "pH and Electrometric Titrations," 2nd. ed., 109–16, Wiley, New York (1941).

[6]Langford, K. E., "Analysis of Electroplating and Related Solutions," 2nd. ed., 34, Draper Limited, Middlesex, England (1958).

[7]Gray, A. G., "Modern Electroplating," 123–4, Wiley, New York (1953).

[8]Graham, A. K., "Electroplating Engineering Handbook," 237, Reinhold, New York (1955).

[9]Blum, W., and G. Hogaboom, "Principles of Electroplating and Electroforming," 3rd. ed., 175, 198, McGraw Hill, New York (1949).

[10]"Metal Finishing Guidebook Directory," 27th. ed., 656–7, Metals and Plastics Publication, Inc., New Jersey (1959).

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Dr. Clarence J. Shoemaker was graduated from Hope College, Holland, Michigan with an AB in 1938. He received a PhD in organic chemistry from Indiana University in 1942. At the present time he is manager of the Ink and Analytical Section of the A. B. Dick Company. He is a member of the American Chemical Society, Phi Lambda Upsilon and Sigma Xi.

PROGRESS TOWARD THE DEVELOPMENT OF A NONEMBRITTLING CADMIUM ELECTROPLATING PROCESS

III. The Use of Triethanolamine In Cadmium Plating Solutions

by P. N. VLANNES, S. W. STRAUSS and B. F. BROWN*

Non-cyanide aqueous baths containing triethanolamine or triethanolamine plus glycine were investigated over a wide range of composition and pH for their characteristics in plating cadmium on ultra-high-strength steel. Plating evaluation included current-density characteristics, embrittlement characteristics, and barrel-plating characteristics including bath life in continuous plating. Results of delayed-fracture tests indicate that under controlled current-density conditions, the triethanolamine bath is nonembrittling.

INTRODUCTION

In a previous paper, it was shown that plating of cadmium from an ammoniacal solution containing salts of amino acids results in markedly lower hydrogen embrittlement than plating from the standard cyanide bath.[1] Studies have been extended on one of the more promising amino acid baths, the cadmium glycinate bath, to determine the desirability of using an organic base instead of ammonium hydroxide to control the *p*H of the bath. The composition of the aqueous glycinate bath was modified with triethanolamine (TEA) additions which not only controlled the *p*H of the solution but also served as a complexing agent for the cadmium. The investigation was extended to determine the characteristcs of triethanolamine-complexed cadmium-plating solutions, and the results are given in the present paper.

BATH COMPOSITION

Screening experiments were performed by plating cadmium from the following: (a) the modified glycinate bath (TEAG) containing 1 M/l cadmium, 0.1 M/l to 2 M/l glycine and 0.25 M/l to 3.77 M/l triethanolamine, (b) glycine-free solutions (TEA) containing the same concentrations of cadmium and of triethanolamine as in (a), and (c) solutions containing 100,-300,500 and 667 grams of $3CdSO_4.8H_2O$, of $CdCl_2.2\ 1/2\ H_2O$, and of Cd $(CH^3COO)_2.2H_2O$ in one liter of pure triethanolamine; it was necessary to heat this last group of solutions in order to solubilize the salts or to effect a uniform mixture. Table I gives compositions and *p*H values for the TEAG and TEA baths used to barrel plate tensile specimens. The composition and *p*H data in Table II are for TEA solutions used to evaluate current-density characteristics when both the salt and TEA concentrations were varied, and to plate tensile specimens under controlled current-density.

CURRENT-DENSITY CHARACTERISTICS

Cadmium-Aqueous TEA Solutions

The Hull Cell method was used to determine current-density characteristics of the TEAG and TEA baths. As

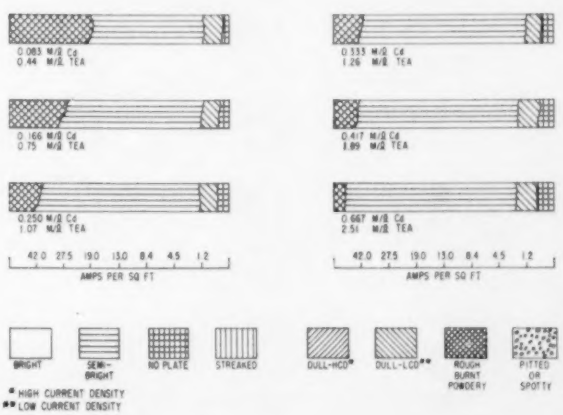

Fig. 1. Hull Cell data for the triethanolamine solutions.

*Physical Metallurgy Branch, Metallurgy Division, U. S. Naval Research Laboratory, Washington 25, D. C.

TABLE I

COMPOSITION OF TEAG AND TEA BATHS USED IN BARREL PLATING EXPERIMENTS

Bath	$3CdSO_4.8H_2O$ (M/l)	TEA (M/l)	*p*H
Modified Glycinate (TEAG)*	1	1.26	7.22
	1	1.31	7.36
	1	1.38	7.50
	1	1.45	7.72
	1	1.52	7.82
Triethanolamine (TEA)	1	3.77	9.91
	1	2.52	8.74
	1	1.89	8.70
	1	1.51	8.02
	1	1.26	7.64
	0.083	0.44	8.02
	0.166	0.75	7.83
	0.250	1.07	7.74
	0.333	1.26	7.76
	0.417	1.89	7.85
	0.667	2.50	7.74

*These baths contain 0.15 M/l glycine.

TABLE II

COMPOSITION OF CADMIUM-TRIETHANOLAMINE SOLUTIONS USED IN PLATING EXPERIMENTS UNDER CONTROLLED-CURRENT-DENSITY CONDITIONS

$3CdSO_4.8H_2O$ (M/l)	TEA (M/l)	*p*H
2.00	0.75	6.23
2.00	1.51	6.55
2.00	3.02	8.03
1.67	0.75	7.04
1.67	1.51	7.54
1.67	3.02	8.32
1.67	4.52	9.04
1.00	0.75	7.56
1.00	1.51	8.04
1.00	3.02	9.36
1.00	4.52	9.76
0.67	0.75	7.98
0.67	1.51	8.65
0.67	3.02	9.26
0.67	4.52	9.56
0.50	0.75	8.45
0.50	1.51	9.18
0.50	3.02	9.76
0.50	4.52	9.92
0.25	0.75	9.18
0.25	1.51	9.80
0.25	3.02	10.08
0.25	4.52	10.18

shown in Fig. 1, the current-density latitude for satisfactory plating from the TEA solutions increased with an increase in the concentration of triethanolamine and of cadmium. Similar results were obtained for the TEAG bath. The best plating range for the TEA bath was about 1 to 27 amp per ft², and that for the TEAG bath about 3 to 25 amp per ft².

The effect upon plating characteristics produced by adding small amounts of each of the following additive materials to the TEAG bath was investigated: chromium acetate, cobalt acetate, nickel citrate, nickel nitrate, copper acetate, copper chloride, copper sulfate, 2-naphtalene sulfonic acid, 3-6 naphtalene disulfonic acid, dextrose, and a commercial brightener. Fig. 2 shows that in general the additives did not increase the plating latitude to any appreciable degree. From Fig. 3 it can be seen that the addition of small amounts of copper salts to the TEAG baths yielded reflective deposits at current densities of about 10 to 40 amp per ft², whereas the same additive in the TEA bath (Fig. 4) gave a satiny deposit. As the concentration of the copper was increased, the plating latitude decreased in both the TEAG and TEA baths. Fig. 5, in which the plating latitude is plotted as a function of the concentration of TEA and of cadmium, indicates that (a) as the cadmium concentration increased the plating latitude increased, up to a concentration of about 1M cadmium, and (b) as the TEA concentration increased the plating latitude decreased. An examination of the Hull Cell plates showed that for a given concentration of cadmium the appearance of the deposit improved as the concentration of the TEA was in-

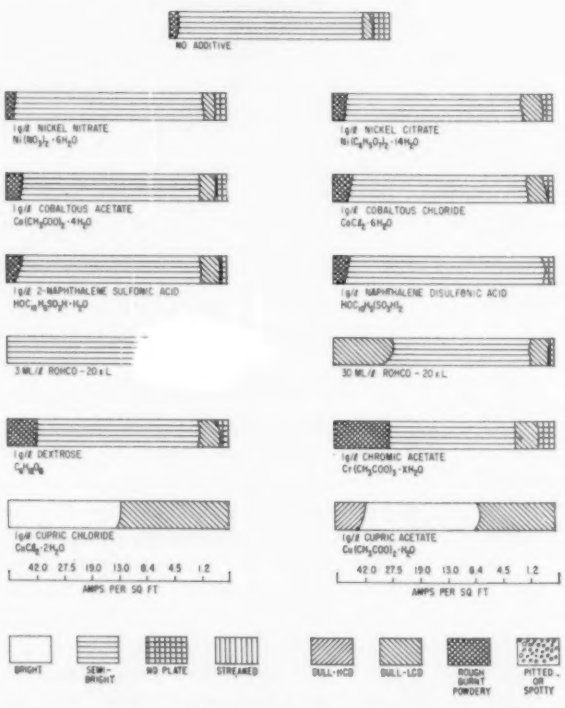

Fig. 2. Hull Cell data for the triethanolamine-glycinate bath with various additives.

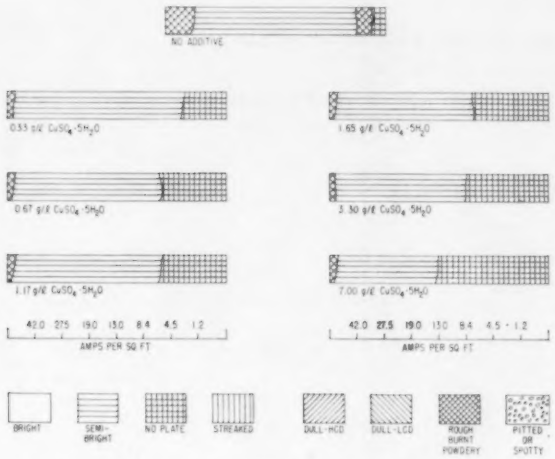

Fig. 3. Hull Cell data for the triethanolamine bath with copper additive.

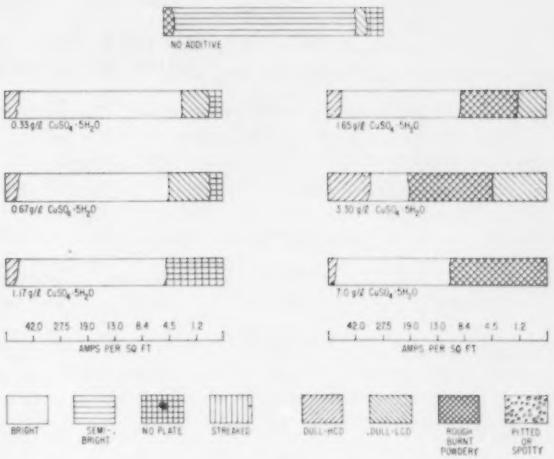

Fig. 4. Hull Cell data for the triethanolamine-glycinate bath with copper additive.

creased. In the absence of TEA adherent deposits could not be obtained.

Cadmium—Pure TEA Solutions

For those solutions containing cadmium salts in pure thriethanolamine, Hull Cell tests were made at two temperatures, approximately 100–110C and at 140–150C, using a ceramic cell in a constant-temperature bath. In some instances the temperature of the solution rose to values as high as 180C, due to the high electrical resistivity of these solutions. Vlthough adherence of cadmium to copper plates was excellent and the deposits smooth, the adherence of the cadmium to steel plates was poor. At high current densities there was a tendency for cadmium crystals to form on the surface of the plate; this effect was more pronounced with steel than with copper plates.

BARREL-PLATING CHARACTERISTICS

The TEAG and TEA baths were found to be satisfactory for barrel plating, using a laboratory-scale barrel and the conditions described in a previous paper. These baths were also subjected to continuous barrel plating, and the results showed that it was possible to plate from these solutions 24 hours a day for 30 days without replenishing any of the constituents,

TABLE III

DELAYED FRACTURE TESTS FOR SPECIMENS BARREL-PLATED FROM THE MODIFIED GLYCINATE BATH*

Bath	Bath Number	Cadmium M/l	Triethanol-amine M/l	Survival Time of Bars: Less Than 100 Hours — Average Survival Time (hrs)	Number of Bars	Per Cent	100 Hours or More (Unembrittled) — Number of Bars	Per Cent
Modified Glycinate	119	1.0	1.26	22	9	36	16	64
(TEAG) 0.15 M	161	1.0	1.31	3	1	33	2+	67
Glycine 1 liter	162	1.0	1.38	13	2	67	1+	33
	163	1.0	1.45	—	—	—	3	100
	164	1.0	1.52	—	—	—	3	100
Standard Cyanide†				0	15	100	—	—

*AISI steel heat treated to 285,000–300,000 psi ultimate tensile strength.
‡Microscopic examination alone.
†Cyanide Bath—3.5 oz CdO and 17 oz NaCN per gal, and 12 oz per 100 gal of R. O. Hull Co.—20 XL brightener. Specimens broke on loading between 40–70 per cent of notched tensile strength.

TABLE IV

DELAYED FRACTURE TESTS FOR SPECIMENS BARREL-PLATED FROM THE TRIETHANOLAMINE BATH*

Bath	Bath Number	Cadmium M/l	Triethanol-amine M/l	Survival Time of Bars: Less Than 100 Hours — Average Survival Time (hrs)	Number of Bars	Per Cent	100 Hours or More Unembrittled — Number of Bars	Per Cent
Triethanolamine (TEA)	116	1.0	1.26	12	3	60	2	40
	156	1.0	1.32	5	2	50	2	50
	107	1.0	1.51	15	13	69	6	31
	105	1.0	1.89	23	3	100	—	—
	101	1.0	2.51	13	11	100	—	—
	103	1.0	3.77	7	3	100	—	—
	147	0.08	0.44	16	1	33	2	67
	148	0.17	0.75	24	3	100	—	—
	149	0.25	1.07	8	3	100	—	—
	150	0.33	1.26	30	2	67	1	33
	151	0.42	1.89	12	3	100	—	—
	152	0.67	2.51	28	3	100	—	—
Cyanide Bath†	—	—	—	0	15	100	—	—

*Specimens were AISI steel heat treated to 285,000 psi ultimate strength. Root radius 0.001 inch.
†Cyanide Bath—3.5 oz CdO and 17 oz NaCN per gal, and 12 oz per 100 gal of R. O. Hull Co.—20 XL brightener. Specimens broke on loading between 40–70 per cent of notched tensile strength.

TABLE V

DELAYED FRACTURE DATA FOR SPECIMENS PLATED FROM THE TEA BATH UNDER CONTROLLED CONDITIONS

Bath Number	Cadmium M/l	TEA M/l	Current Density* (Amp/ft2)	Survival Time of Bars: Average Survival Time (hrs)	Less Than 100 Hours — Number of Bars	Per Cent	100 Hours or More — Number of Bars	Per Cent
215	2	1.51	15.00	—	—	—	3	100
210	2	3.02	19.20	—	—	—	3	100
218	1.67	1.51	12.80	—	—	—	3	100
219	1.67	3.02	15.00	—	—	—	3	100
195	1.00	1.51	19.20	—	—	—	3	100
196	1.00	3.02	12.80	—	—	—	3	100
199	0.67	1.51	19.20	—	—	—	3	100
200	0.67	3.02	8.96	—	—	—	3	100
204	0.50	1.51	15.00	—	—	—	3	100
205	0.50	3.02	5.12	51	1	33	2	67
207	0.25	1.51	8.00	—	—	—	3	100
208	0.25	3.02	5.12	—	—	—	3	100
168	1.00	1.51	38.40	13	1	50	1	50
169	1.00	1.26	19.20	7	1	20	4	80

*Taken from Hull Cell experiments.

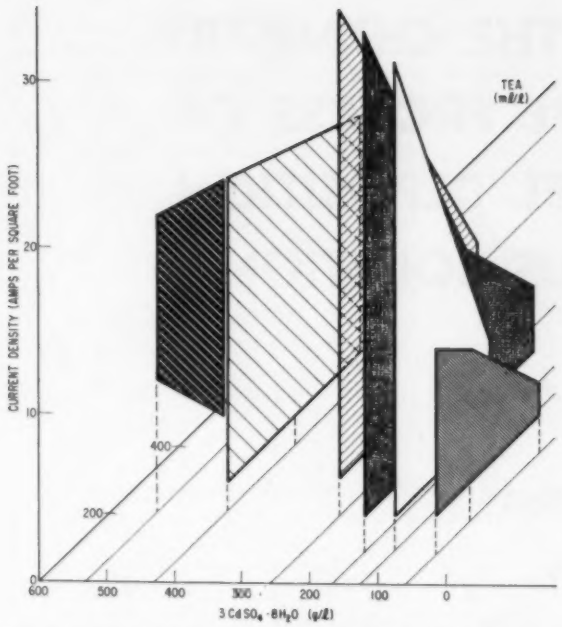

Fig. 5. Plating latitude of various cadmium triethanolamine solutions.

except for maintaining a constant volume of liquid by periodic additions of distilled water and renewal of the cadmium anodes.

EMBRITTLEMENT CHARACTERISTICS

The delayed-fracture test and the method of evaluating the test results were described in previous papers.[1, 2] Delayed fracture data for TEAG barrel-plated tensile bars are given in Table III, and Table IV contained similar data for TEA barrel-plated specimens; the data for cyanide plated specimens are included for comparative purposes. The results show at the TEAG and TEA baths are comparable to each other and that both baths are superior to the cyanide bath, from the standpoint of hydrogen embrittlement.

In barrel plating, it is difficult to control the current density; therefore, in order to obtain a more accurate evaluation of the behavior of these baths, additional specimens were plated from the TEA bath under controlled-current-density conditions with a cylindrical cadmium anode and a concentric rotating delayed-fracture test bar. The delayed-fracture data in Table V show that out of a total of 43 specimens tested, 40 specimens, or 93 per cent, survived the 100-hour test. These results suggest that under controlled-current-density conditions the TEA bath fulfills the criteria for nonembrittlement as set forth in this series of papers.

SUMMARY

1. The plating characteristics of aqueous cadmium baths containing triethanolamine (TEA) or triethanolamine plus glycine (TEAG) with and without additives, have been investigated. Satisfactory plates were obtained from these solutions, the concentration of cadmium being set at 1M/l and the concentration of TEA for proper control of the bath being set at 1.26 to 1.51 M/l; in the case of the TEAG bath the concentration of glycine was 0.15 M/l for optimum plating conditions.

2. Continuous plating, using a horizontal plating barrel, showed that it was possible to plate from the TEA and TEAG baths 24 hours a day for 30 days without attention, except for maintaining a constant volume of liquid by periodic additions of distilled water and renewal of the cadmium anodes.

3. Results of delayed-fracture tests, using plated cylindrical notched tensile specimens of AISI 4340 steel heat-treated to approximately 285,000 psi ultimate tensile strength, and subjucted to an applied load of 75 per cent of the notched tensile strength of the unplated specimen, indicate that under controlled-current-density conditions the TEA bath is nonembrittling.

REFERENCES

[1]Vlannes, P. N., and S. W. Strauss, "Progress Toward the Development of a Nonembrittling Plating Bath. II. Use of Aliphatic Amino Acids as Complexing Agents in Aqueous Baths," Plating, **46**, 1046–1051 (1959).

[2]Raring, R. H., and J. A. Rinebolt, "A Small and Inexpensive Device for Sustained Loading Testing" ASTM Bull. No. 213, pp. 74–76, April 1956.

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AN OUTLINE OF THE CHEMISTRY INVOLVED IN THE PROCESS OF CATALYTIC NICKEL DEPOSITION FROM AQUEOUS SOLUTION

PART I

by G. GUTZEIT*

INTRODUCTION

Selective deposition by *catalyzed* reduction of an adherent, amorphous, nickel (85–97 per cent)-phosphorus (3–15 per cent) coating on metallic substrates from aqueous solutions—so-called "electroless" nickel plating as opposed to electroplating—was described by Brenner and Riddell of the National Bureau of Standards in 1946–47,[1, 2] and later (1947–1952) developed further by General American Transportation Corporation into a large-scale production process (also suitable for non-metals) known under a registered trade name.** It has today gained acceptance by many progressive industries for numerous applications, which take advantage of its unique qualities—such as uniform thickness regardless of shape or nature of the base material; hardness which can be further increased by heat treatment; relative freedom from porosity; and superior corrosion resistance—due to the particular character of this "metallic glass."

The process is based on the controlled, autocatalytic reduction of nickel cations by means of hypophosphite anions in the presence of water. While both alkaline and acid solutions have been used, most commercial baths today operate at *p*H values below 6.0. According to A. Brenner, the significant gross equations can be written:

(I)

$$\underset{\text{Nickel Cation}}{Ni^{++}} + \underset{\text{Hypophosphite Anion}}{[H_2PO_2]^-} + \underset{\text{Water}}{H_2O} \xrightarrow{\text{Catal. (Ni°)}} \underset{\text{Metallic Nickel}}{Ni^\circ} + \underset{\text{Hydrogen Cations}}{2H^+} + \underset{\substack{\text{Acid Ortho-phosphite Anions}}}{H[HPO_3]^-}$$

$$\triangle F_{25} = -11.5 \text{ K cal/mole}$$

Concurrently, more hypophosphite anions are oxidized to orthophosphite anions with evolution of gaseous (molecular) hydrogen through the catalytic action of the metallic nickel formed in reaction (I):

$$[H_2PO_2]^- + H_2O \xrightarrow{\text{Catal. (Ni°)}} H[HPO_3]^- + H_2\uparrow \quad \text{(II)}$$

$$\triangle F_{25} = -23 \text{ K cal/mole}$$

Moreover, some of the hypophosphite is reduced to supply ultimately the elemental phosphorus which "alloys" with the metallic nickel. Nickel being a catalyst for both reactions (I) and (II), the process is self-sustaining.

Standard textbooks of Inorganic Chemistry[3] teach that the hypophosphorous anion is a strong reducing agent. It precipitates from their salts silver, gold, the platinum group metals and even mercury, copper and bismuth at room temperature in the elementary state. Nickel (and cobalt) ions can be reduced to the metals at higher temperature under specific conditions, to be discussed later.

PART I

REACTIONS

Oxidation of Hypophosphite

The kinetics of the homogeneous oxidation of hypophosphites with halogens, respectively $CuCl_2$ and $HgCl_2$, have been investigated by A. D. Mitchell (J. Chem. Soc. 1920, 117, 1322 and 1922, 121, 1624) and by H. O. Griffith and A. McKeown (Trans. Faraday Soc. 1934, 30, 530).

In alkaline solution and at elevated temperature, the hypophosphite anion oxidizes spontaneously to orthophosphorous anion with liberation of molecular hydrogen:

$$[H_2PO_2]^- + OH^- \longrightarrow [HPO_3]^{--} + H_2 \quad \text{(III)}$$

However, in neutral or acid medium, catalysts are required in order to promote this reaction. For instance, if a drop of palladium chloride is added to an acidified hypophosphite solution, the former is immediately reduced to palladium sponge, which will further catalyze unlimited quantities of $[H_2PO_2]^-$ into H_2 and phosphite anion:

$$[H_2PO_2]^- + HOH \xrightarrow{\text{Cat.}} H[HPO_3]^- + H_2 \quad \text{(IV)}$$

The heterogeneous (catalytic) oxidation of hypophosphorous acid has been the subject of several studies,[4] which

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NOTE—This paper was first presented at the Annual Meeting of the American Chemical Society in Boston, Mass., April 1959.

are of great interest in connection with the understanding of the mechanism of chemical nickel deposition.

While earlier investigators, such as Bach[5] and Sieverts[6] considered reaction (IV) as a reduction of the water molecule by hypophosphorous acid, H. Wieland and A. Winkler[7] postulated, on the basis of organic analogies, that catalytic dehydrogenation of the hypophosphorous acid molecule was taking place according to the equation:

$$H[H_2PO_2] \xrightarrow[\text{Catal.}]{-2H} H[PO_2] \qquad (V)$$

Hypophosphorous Acid → Metaphosphorous Acid

and

$$H[PO_2] + H_2O \longrightarrow H_2[HPO_3] \qquad (VI)$$

Metaphosphorous Acid → Orthophosphorous Acid

It should be remembered that the active metals promoting reaction (V) are hydrogenation-dehydrogenation catalysts; and that, as will be shown later, specific catalytic poisons even in trace quantities dramatically slow down the rate of this hypophosphite oxidation.

Wieland and Winkler's hypothesis was later confirmed by Franke and Moench,[8] who, using deuterium as "tracer atoms," demonstrated that the hypophosphite anion is dehydrogenated by catalytic metals belonging to the platinum group, yielding ultimately orthophosphorous acid and hydrogen gas.

Reduction of Nickel Ions by Hypophosphite

The reduction of nickel ions to the metal was observed and described by A. Wurtz as early as 1844.[9] If an aqueous, concentrated solution of sodium hypophosphite also contains nickel cations, a spongy or lustreous metallic precipitate will appear eventually after prolonged heating to about 100C. In dilute solution, a solid catalyst is required. P. Breteau[10] further studied this reaction, which was later investigated more throughly by L. Frederici (Doctoral thesis) and by C. Paal and L. Frederici.[11] These authors state that the bright metallic, non-adherent coating produced on the glass walls of the flask by Breteau after several hours of heating, using a solution of 20 g of nickel sulfate and 100 g of sodium hypophosphite in 450 cm³ of water, contained from 13.08 to 14.17 per cent phosphorus. Repeating the experiment in ammoniacal solution, Paal and Frederici found that the reduction took place much more rapidly and with lower concentrations of hypophosphite (40 g/l). The product, consisting of lustreous flakes, analyzed only 2.7–3.3 per cent P. In the presence of organic anions such as tartrates or acetates, the solution was quite stable and did not spontaneously decompose even after prolonged heating. However, upon addition of a small amount of palladium (0.00001 g Pd/g of nickel), a heavy, dark metallic precipitate was formed immediately, which was stated to contain nickel, phosphorous and oxygen(?) —the latter determined by difference. Thus, the compounds obtained from tartaric solution analyzed 76.98–78.05 per cent Ni and 6.30–9.20 per cent P. In acetic medium, the results were 89.71 per cent Ni and 6.08 per cent P.

In December 1916, a U. S. Patent (No. 1,207,218) was granted to F. A. Roux of Paris, France, covering production of metallic deposits on solid bodies (particularly those made of aluminum) by "steeping the articles to be treated, until sufficiently metallized . . . in a hot bath containing a solution of citrate of nickel, an alkaline hypophosphite and ammonia." This patent discloses basically the process of "electroless" nickel plating, although the specification does not indicate reagent concentrations and other necessary conditions for successful *selective* nickel deposition. Obviously the claims are much too broad for practical use.

"Electroless" Catalyzed Nickel Deposition

In February 1944, Brenner and Riddell of the U. S. National Bureau of Standards discovered by accident the principle of controlled deposition of nickel-phosphorous on a catalytic surface. They were developing a process for plating the interior of steel tubes with nickel-tungsten alloy, using an ammoniacal solution containing citrate and an insoluble inside electrode. In one experiment, sodium hypophosphite was added to decrease the extent of anodic oxidation of the citrate, which caused the deposits to exfoliate. The results were surprising: The outside of the tube was completely coated, and the cathode current efficiency was about 120 per cent, although vigorous gassing had been observed during the operation. This indicated that chemical deposition was occurring concurrently with electroplating. An investigation revealed that this chemical reaction is autocatalytic, and could be controlled "with the virtual exclusion of the purely chemical reduction." A laboratory method, published in July 1946[1] (R.P. 1725), was developed whereby, under specified conditions of concentration and at high *p*H, nickel could be deposited on iron, nickel, gold, cobalt, palladium and aluminum, but not on platinum, copper, zinc or lead. All the baths described contain 30 g/l of nickel chloride hexahydrate and 10 g/l of sodium hypophosphite monohydrate (as compared to about 200 g/l used by Breteau); the *p*H was adjusted to 8–9 with ammonia (or caustic soda); moreover, large quantities of ammonium salts and/or citrate ions were added, in order to "keep nickel in solution" despite the alkalinity. (Note that this bath composition is *qualitatively* identical to that claimed by Roux[12]). It is stated that the "preferential deposition" (upon the catalytic surface only) was made possible by employing dilute solutions of hypophosphite. Coating rates on steel were 0.2 to 0.3 mils* per hour at a temperature "at or above 90C." The preferred plating solution was as follows:

$NiCl_2 \cdot 6H_2O$	30 g/l
$NaH_2PO_2 \cdot H_2O$	10 g/l
NH_4Cl	50 g/l
$Na_3C_6H_5O_7 \cdot 5\ 1/2H_2O$	100 g/l
Rate of deposition—in./hr.	0.00025
Appearance of Deposit	Semi-bright
Alkali for adjusting *p*H	NH_4OH
*p*H	8 to 9

The baths are stable for several days at room temperature, and "fairly stable" at elevated temperature—they can be kept at 90C for 5 hours "without deteriorating very much." The deposits contain about 97 per cent Ni and 3 per cent P. The rate of deposition increases rapidly with temperature. The coating thickness obtained in 30 minutes was found to be 0.0155 mils at 54C, 0.0640 mils at 78C and 0.11 mils at 92C.

The authors state correctly that "in practice, the use (of alkaline-nickel baths) is inconvenient and uneconomical, because at the high temperature (90–92C) of operation, there is a rapid loss of ammonia, and the fumes are disagreeable."

Pursuing further their investigations, Brenner and Riddell extended the method—for which they suggested the name "electroless plating"—to include the deposition of nickel from

*1 mil = 0.001 in. or 25 microns.

acid solution,[8] (RP 1835, Nov. 1947), "which is more easily controlled," and produces coatings at a faster rate.

Typical N.B.S. acid baths, which result in semi-bright, smooth deposits, are given in Table I.

TABLE I[7]
TYPICAL BATH COMPOSITIONS
ACCORDING TO BRENNER & RIDDELL

	1 g/l	2 g/l	3 g/l
Nickel chloride, $NiCl_2 . 6H_2O$	30	30	30
Sodium hypophosphite, $Na(H_2PO_2) . H_2O$	10	10	10
Sodium hydroxyacetate, $NaC_2H_3O_3$	50	10	—
Sodium citrate, $Na_3C_6H_5O_7 . 5\ 1/2H_2O$	—	—	10
Rate of deposition—in./hr	0.0006	0.0005	0.0002
*p*H	4 to 6	4 to 6	4 to 6

Referring to equation I (p.1158) it can be seen that hydrogen ions are formed in the reaction. When the *p*H reaches about 3, the rate of nickel deposition becomes very low. In order to prevent rapid drop in *p*H, salts of organic acids are added as buffers (sodium citrate, sodium hydroxyacetate). Furthermore, these hydroxycarboxylic anions "prevent precipitation of basic nickel compounds." Obviously, this is due to complexing of the nickel ions by chelate formation.

The authors show that buffer concentration must be carefully regulated, in order to obtain the highest deposition rates.

Their data indicate an optimum buffer concentration which is both dependent upon bath composition and the chemical nature of the organic anion, as shown below:

Solution A		Solution B	
Nickel sulfate	35 g/l	Nickel chloride	30 g/l
Sodium hypophosphite	10 g/l	Sodium hypophosphite	10 g/l

Solution	Concentration of Acetate Anion g/l	Thickness of Deposit in mils/hr	Concentration of Sodium Glycolate g/l	Thickness of Deposit in mils/hr
A	2.0	0.75	10	0.10
	4.3	1.00	50	0.40
	6.5	0.40	100	0.33
			200	0.28
B	1.0	0.20	10	0.40
	2.5	0.60	50	0.60
	6.5	0.10	100	0.70
	20.0	0.06		

This observation, made by several investigators for some additives (buffers and mild chelating agents),[13] is not generally true. In the case of organic compounds which form relatively stable complexes with the nickel ion, the rate of deposition is an inverse function of their concentration.[14]

On the other hand, it is stated that tartaric, malic, gluconic and formic acids are unsatisfactory, because negligible amounts of nickel are deposited in their presence. This point will be discussed in PART II.

The authors offered the following conclusions concerning reaction mechanism.

1. (a)—In the alkaline bath, the rate of deposition of nickel-phosphorus alloy was found to be approximately proportional to the hypophosphite concentration, as shown in Table II.

TABLE II[7]

Concentration g/l	Rate of Deposition Per Hour in. $\times 10^{-4}$
SODIUM HYPOPHOSPHITE	
2	0.3
4	0.6
10	2.4
50	7.5
NICKEL	
3.8	2.2
7.5	2.6
15.0	3.0

1. (b)—In the *acid* bath, the concentrations of nickel and hypophosphite ions may vary considerably: The nickel content may be increased from 3 to 50 g/liter without appreciably altering the rate of deposition (although, with a nickel concentration of 100 g/l, this rate is somewhat decreased).

Sodium hypophosphite can be used in concentrations from 10 to 100 g/l without appreciably affecting the rate of the process.

2.—The yield of the reaction, calculated on the hypophosphite, is a function of the ratio solids area/solution (plating bath volume) A/V. If A is large relatively to V, the average efficiency is 37 per cent (i.e., about 2g of nickel, as ions, are reduced by 10g of sodium hypophosphite). If, on the other hand, the solution volume V is large relatively to area A, the efficiency is only 20 per cent.

3.—In the acid bath, the catalytic decomposition of hypophosphite with the production of hydrogen does not occur at metallic surfaces in the absence of dissolved nickel salts.

4.—Iron, nickel, gold, cobalt, aluminum and palladium were found to have catalytic properties that initiate the reduction of the nickel immediately upon their introduction into the hot solution.

The present author, on the basis of experimental evidence, has developed different concepts, applicable to acid baths.

Reaction Mechanism (Nickel Deposition)

In order for the reaction (i.e., the catalytic reduction of nickel ions to an amorphous nickel-phosphorus alloy) to take place, the presence of water is required. When a plating bath is prepared wherein H_2O is replaced by increasing amounts of dioxane, the deposition rate decreases until (at 35 volume per cent dioxane) the reduction stops altogether.

The bath used for these studies[14, 20] contained:

Nickel ions (as nickel sulfate hexahydrate)	0.08 M
Hypophosphite ions (as sodium hypophosphite monohydrate)	0.25 M*
Lactic ions (as 80 per cent acid)	0.30 M*
Lead ions (as lead nitrate)	2.00 ppm
Sodium hydroxide	to *p*H 4.6

The temperature was kept constant at 99C by close thermostatic control. The solid specimens were freshly pickled 20 cm^2 (steel shim stock) steel platelets, immersed in 50 cc of solution. The rates of deposition were measured by weighing the dry samples before the tests and after 10 minutes of coating. The rate R is expressed in Table III as R $\times 10^4$ g/cm^2—min.

*Patented in the United States and abroad.

TABLE III

RATE OF DEPOSITION AS A FUNCTION OF DIOXANE CONCENTRATION

Volume per cent Dioxane	None	5%	10%	20%	25%	35%
R × 10^4 g/cm² −min	2.87	2.80	2.50	1.92	1.68	zero
Plating appearance	Semi-bright		Dull			None

Further, it was confirmed that, in the alkaline bath, the rate of deposition of the solid nickel-phosphorous alloy is substantially proportional to the hypophosphite concentration. It was moreover shown that, in the acid bath covering a range of concentrations from 0.02 to 0.12 M of nickel ions and from 0.05 to 0.80 M of hypophosphite ions, with a 1:1 mixture of acetic acid and sodium acetate (0.50 M each) as buffer, and lead ions as stabilizer (0.5 to 2 ppm depending on the temperature of the test), the rate of deposition is also proportional to the hypophosphite concentration, *provided* the A/V ratio is small and a sufficient amount of buffer is present to keep the *p*H practically constant during the whole reaction period.

It soon became apparent that the data obtained in preliminary tests did not fit the bimolecular rate law, as would be expected from equation I. One possible reason for the deviation from bimolecularity could be complex ion formation between nickel and acetate ions, or between nickel and hypophosphite ions. In order to ascertain whether or not this was the case, a solution was prepared containing 0.10 M of Ni^{++} (as sulfate). The maximum absorption wave length was measured in a spectrophotometer and occurred at 400 mμ. Using this wave length for subsequent determinations, a series of solutions was prepared containing 0.10 M of nickel ions, with varying amounts of sodium hypophosphite (from 0.05M to 1.0 M). The per cent transmission as a function of hypophosphite concentration was determined, and no change was found. Utilizing the same technique, the effect of the acetate ion concentration (from 0.05 to 0.6 M) was studied, and showed the same negative results. It was therefore concluded that no complex formation with Ni^{++} was taking place.

Tables IV and V show the variation in deposition rate as a function of Ni^{++} and of $[H_2PO_2]^-$ concentration, in a highly buffered solution (0.5 M acetic acid and 0.5 M sodium acetate) having a *p*H value of 4.5–4.6 at A/V 40cm²/500cm³, temperature (thermostatically controlled oil bath) 98.7C.

TABLE IV

HYPOPHOSPHITE ANION CONCENTRATION CONSTANT 0.23 M
NICKEL CATION CONCENTRATION ($NiSO_4 \cdot 6H_2O$) VARIABLE FROM 0.02 TO 0.12 M

Ni^{++} M	Rate of Deposition R × 10^4 g/cm²—min
0.02	2.27
0.03	2.83
0.05	2.82
0.07	2.89
0.10	3.01
0.12	2.84

TABLE V

NICKEL CATION CONCENTRATION CONSTANT 0.10 M ($NiSO_4 \cdot 6H_2O$)
HYPOPHOSPHITE ANION CONCENTRATION ($NaH_2PO_2 \cdot H_2O$) VARIABLE FROM 0.05 TO 0.80 M

$[H_2PO_2]^-$ M	Rate of Deposition R × 10^4 g/cm²—min
0.05	0.35
0.10	0.89
0.20	2.25
0.30	3.66
0.40	4.26
0.60	5.01
0.70	5.82
0.80	5.91

The above data support the postulation of a mechanism of the first order, at least within the concentration range where the catalytic reaction occurs preferably. (See Fig. 1.) In other words, they indicate that the plating reaction undergoes intermediate steps. A scheme, by which this reaction would occur and still yield a first order dependence upon the hypophosphite concentration can be assumed as follows: Let A = the concentration of hypophosphite; B = some active intermediate specie whose existence or average life is very short, being generated and destroyed at a constant rate; and C = concentration of nickel; one could then write:

$$(1)\quad A \underset{K_{-1}}{\overset{K_1}{\rightleftarrows}} B$$

$$(2)\quad C + B \xrightarrow{K_2} \text{products}$$

Therefore, the rate of decrease of nickel with time

$$\frac{-dc}{dt} = K_2\,(C)\,(B)$$

$$(3)\quad \frac{dB}{dt} = K_1\,(A) - K_{-1}\,(B) - K_2\,(C)\,(B) = 0$$

$$K_1\,(A) = K_{-1}\,(B) + K_2\,(C)\,(B)$$
$$K_1\,(A) = (K_{-1} + K_2C)\,(B)$$

$$(4)\quad \frac{K_1\,(A)}{K_{-1} + K_2C} = (B)$$

$$(5)\quad \frac{-dC}{dt} = \frac{K_2\,K_1\,(C)\,(A)}{K_{-1} + K_2C}$$

If $K^{-1} \ldots K_2C$ then $\frac{-dC}{dt} = \frac{K_2\,K_1\,(C)\,(A)}{K_2\,(C)}$ and,

dividing by $K_2\,(C)$ $\frac{-dC}{dt} = K_1\,(A)$

In words, the deposition rate of nickel would, in that case, be proportional only to the concentration of the hypophosphite ion.

The critical test of any rate expression further involves a functional relationship of rate with temperature (the so-called

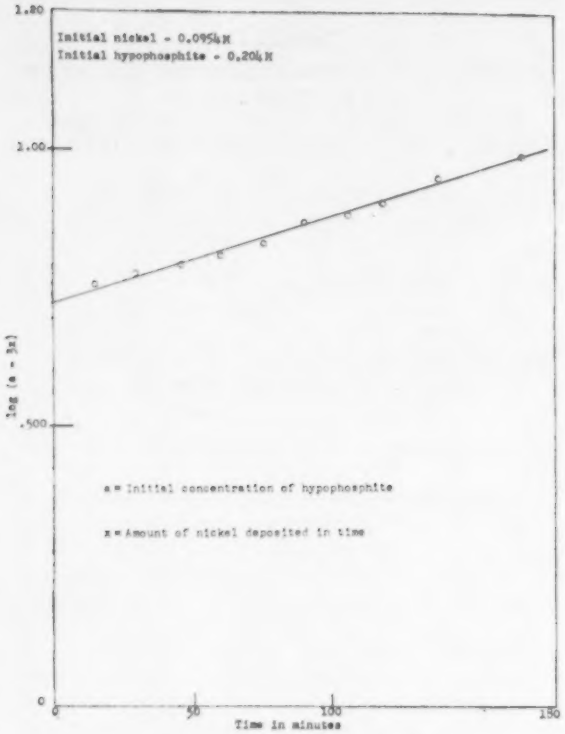

Fig. 1. Deposition rate of nickel, $\log_{10}$ hypo vs time, first order plot, temperature 96C.

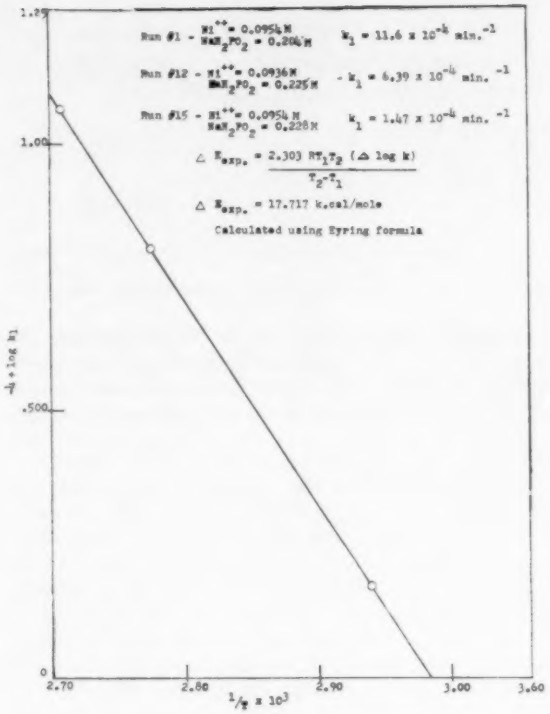
Run #1 - Ni++ = 0.0954M, NaH2PO2 = 0.204M, k1 = 11.6 x 10-4 min.-1
Run #12 - Ni++ = 0.0936M, NaH2PO2 = 0.225M, k1 = 6.39 x 10-4 min.-1
Run #15 - Ni++ = 0.0954M, NaH2PO2 = 0.228M, k1 = 1.47 x 10-4 min.-1
Δ Eexp. = 2.303 RT1T2 (Δ log k) / T2-T1
Δ Eexp. = 17.717 k.cal/mole
Calculated using Eyring formula
1.50
1.00
.500
0
-4 + log k1
2.70
2.80
2.90
3.00
3.60
1/T x 10^3

Fig. 2. Temperature dependence plot of log k_1 vs 1/T.

Arrhenius plot). The Arrhenius law states that, over a reasonable interval of temperature, the logarithm of the rate constant plotted against the reciprocal of the absolute temperature should be a stright line. This is demonstrated for the chemical plating reaction in Fig. 2. A few typical results obtained in a large series of experiments are given in Table VI.

From the data in Table VI, the energy and the entropy of activation can be calculated:

a) The activation energy computed from tests Nos. 1, 12 and 15 using the Eyring equation $\triangle E$ exp. = $\frac{2.303\ RT_1T_2\ (\triangle \log K)}{T_2 - T_1}$ gives $\triangle E$ exp. = 17.7 K. cal/mole.

b) The entropy of activation computed from the same tests Nos. 1, 12 and 15, using the relationship—$\triangle S = 2.303\ R \log \frac{K_r h}{kTe} + \triangle E^{\ddagger}/T$ (where K_r = rate constant in units 1/mole—sec; e = 2.7183 and k = R/N = 1.380×10^{-16}; h = 6.624×10^{-15})—gives $\triangle S^{\ddagger}$ = 20.4 cal/degree mole.

The above parameters indicate the energy barrier which must be surmounted before deposition can occur, and also the degree of probability (randomness) of the intermediate transitional compound.

This short-lived, intermediate specie B could be an "active" form of hypophosphite. It appears much more probable that

TABLE VI

RATE OF DEPOSITION AS A FUNCTION OF NICKEL AND HYPOPHOSPHITE CONCENTRATION AND OF TEMPERATURE IN A HIGHLY BUFFERED BATH

No.	Temp. °C	Init. Ni^{++} Concentr. mpl	Init. $[H_2PO_2]^-$ Concentr. mpl	$K \times 10^4$ min.$^{-1}$	Init. *p*H	Final *p*H	% Ni in Coating
1	96	0.0954	0.204	11.60	4.56	4.43	93.5
3	96	0.0628	0.175	9.36	4.58	4.54	94.0
5	96	0.1440	0.230	9.59	4.50	4.30	95.2
10	87	0.1090	0.230	9.60	4.52	4.43	93.7
12	87	0.0936	0.225	6.39	4.50	4.30	92.9
14	67	0.0843	0.230	1.49	4.47	4.37	92.2
15	67	0.0954	0.228	1.47	4.45	4.32	91.9

it is atomic hydrogen* adsorbed on or loosely bonded to the catalytic surface, i.e., a nickel hydride in the broadest sense,† as is indicated by other facts, and is in accordance with the Wieland and Winkler[7] hypothesis, confirmed by Franke and Moench,[8] which was mentioned earlier in this paper.

Therefore, it is suggested that the equations representing the catalytic reduction of nickel ions by hypophosphite be written:

$$\left\{\begin{array}{l} [H_2PO_2]^- \xrightarrow{\text{Catal. (Ni°)}} [PO_2]^- + 2H(\text{Cat.}) \quad \text{(VII)}^* \\ [PO_2]^- + H_2O \longrightarrow H^+ + [HPO_3]^{--} \quad \text{(VIII)} \end{array}\right.$$

$$Ni^{++} + 2H(\text{Cat.}) \longrightarrow Ni° + 2H^+ \quad \text{(IX)}$$

Equation VII shows that hypophosphite anions are dehydrogenated catalytically to metaphosphite ions.‡ Equation VIII expresses the fact that the metaphosphite ion *immediately* combines with water to form orthophosphite ion. It should be noted that the formation of hydrogen ions takes place (Eq. VIII), supporting the *p*H dependency of reactions VII + VIII. The rate of these two reactions is greater than that of reaction IX.

Equation IX represents the reduction of nickel ions to metallic nickel by active hydrogen atoms adsorbed on or loosely bonded to the catalytic surface, resulting in the formation of hydrogen ions. The free energy of this reaction is $\triangle F_{25}° = -82$ Kcal. (±5 per cent).

Reaction Mechanism (Phosphorus Deposition)

Insofar as the deposition of phosphorous is concerned, no mechanism can be proposed which is clearly supported by the facts. We know from X-ray diffraction studies that the product of the reduction is not a crystalline chemical compound, but an amorphous solid with the structure of an over-cooled liquid, containing variable amounts of phosphorous depending chiefly on *p*H (and to some extent on bath composition). For instance, plating 20 cm² Armco iron samples in 250 cm³ of a bath designated LP (which contains 0.08 moles/l of Ni^{++}; 0.225 moles/l of $[H_2PO_2]^-$; 0.300 M of lactic acid; 0.03 M of propionic acid and traces of stabilizer)§ for 15 minutes, the following results shown in Table VII were obtained:

TABLE VII
PHOSPHORUS CONTENT OF DEPOSIT AS A FUNCTION OF BATH *p*H

Initial *p*H	Final *p*H	Aver. Wgt. gain	Moles/liter of H_2 evolved (minus blank)	Phosphorus content of deposit
5.5	4.55	0.1047	0.00355	7.5%
5.0	4.45	0.0918	0.00343	8.7%
4.5	4.21	0.0858	0.00294	9.4%
4.0	3.90	0.0448	0.00178	10.3%
3.5	3.45	0.0223	0.00058	14.6%

*Bonhoeffer determined that the half-life period of the H atom is ⅓ second (at 0.5 mm pressure).

†P. Hersch (Devel. and Rsch. Dept., The Mond Nickel Co., Ltd., Birmingham, England) suggested, on the basis of analogy with reduction of nickel salts by borohydride BH_4^-, that hypophosphite acts not as a donator of atomic hydrogen, but of the hydride ion

$$[H_2PO_2]^- + O^{--} \longrightarrow [HPO_3]^{--} + H^-$$

The hydride ion would then react further

$$H^- + H^+ \longrightarrow H_2$$

$$H^- + Ni^{++} \longrightarrow H^+ + Ni°$$

and also be responsible for the reduction of $[H_2PO_2]^-$ to P. The hydride hypothesis would demand the existence of a labile intermediate molecule HPO_2, an isomer of metaphosphorus acid OPOH.

‡Dr. John R. Van Wazer (of Monsanto Chemical Co.) believes that the formation of metaphosphite as a reaction intermediate is unlikely, because metaphosphorous acid is probably a ring compound (private communication). As reactions (VII) and (VIII) can be considered simultaneous, they can be written in summation $[H_2PO_2]^- + H_2O \xrightarrow{\text{Cat.}} H^+ + [HPO]_3^{--} + 2H$ (Cat.) which points out the dehydrogenation of hypophosphite and the formation of transitional atomic hydrogen (bonded to the catalyst), without the requirement for $[PO_2]^-$ as an intermediate compound.

§Patented in the United States and abroad.

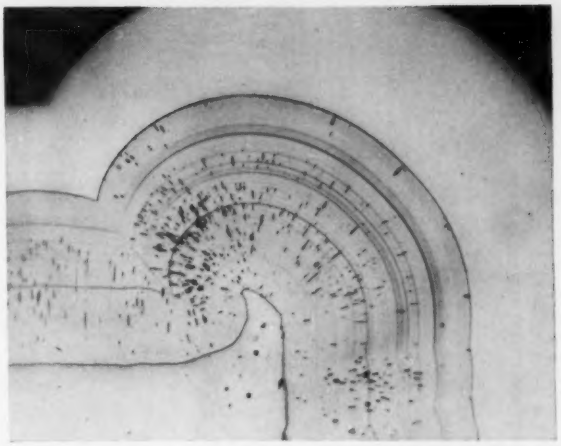

Fig. 3. Microstructure of 10 mil chemically reduced Ni on steel illustrating the growth of chemically reduced Ni around the burr of a sheared edge.

A metallographic study of the chemically reduced nickel deposits[15] reveals a particular array of parallel striations. These striations are characteristic of periodic variations of composition (presumably phosphorus). Evidence that the striations in the as-deposited chemically reduced nickel reflect variations in phosphorus content may be observed in microstructures of heat-treated deposits. By heat treatment (400C), the metastable as-deposited state reverts to the equilibrium phase mixture of the inter-metallic compound Ni_3P in a matrix of nickel (containing very little P). The population of Ni_3P particles may be used as an indication of the original P content. Figs. 3, 4 and 5 show the appearance of one of the original striations after heat treatment, and it can be seen that the number of Ni_3P particles within the light striation is less than on either side of it.

Further indication of periodic variations in phosphorus content was supplied by determining potential variations during the stripping of the coating, using a slow acting (passivating) solvent. It is well known that nickel phosphides are dissolved at a much lower rate than elemental nickel by such acids as concentrated HNO_3. The potential of chemical nickel was measured against the potential of a glass electrode during attack by red fuming nitric acid, with a Leeds and Northrop K_2 potentiometer at 20C. The E.M.F. was practically constant (320 ± 2 —1 mv) for 65 minutes, then dropped to 300 mv and stayed constant at that value for 35 minutes, to rise slowly again to 320 mv in 10 further minutes. It was substantially constant at that level for 60 minutes; dropped to 305 mv for 20 minutes, and started rising again to 320 mv, etc. (See Fig. 6). Another qualitative test gave additional confirmation to this periodicity. E.M.F. was recorded while a nickel coupon was nickel* coated in the above described LP bath using a salt bridge and a calomel electrode as the other half-cell. The graph obtained showed strong periodic potential "peaks" in one single direction superposed upon continual short frequency variations. No satisfactory explanation could be found for this phenomenon, although several hypotheses may be advanced. It can be suggested, for instance that, as the phosphorus content of the deposit increases (due to a drop in *p*H near the catalytic surface by adsorption or slow diffusion of H^+ ions), the catalytic prop-

*Kanigen process.

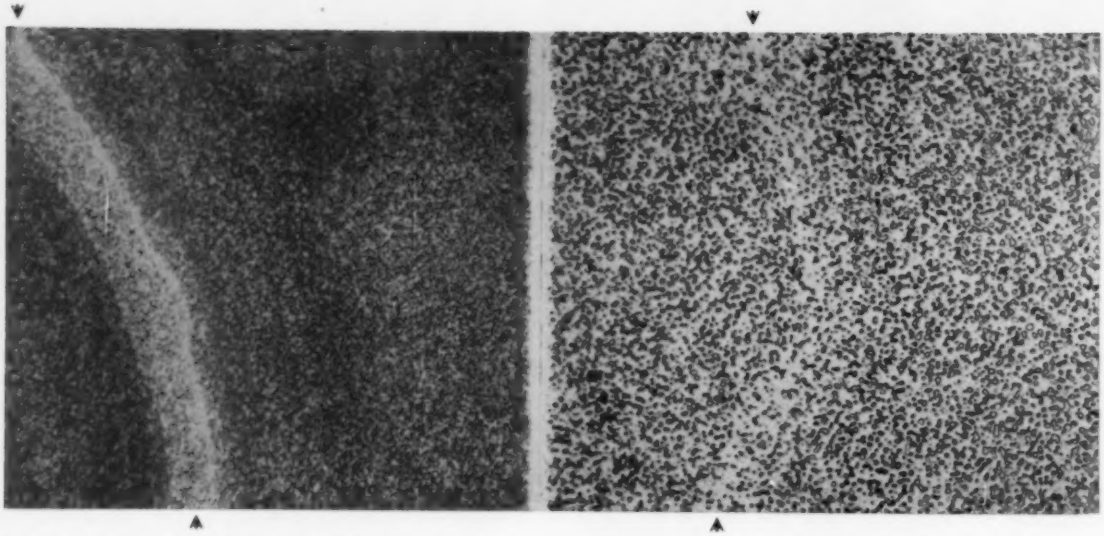

Fig. 4. Structure of chemically reduced Ni after heat treatment for 1 hr at 600C; dispersions of Ni_3P in a matrix of Ni.

Fig. 5. Structure of chemically reduced Ni after heat treatment for 1 hr at 800C; dispersions of Ni_3P in a matrix of Ni.

erties of said surface change rather abruptly when a certain threshold is reached.

Scholder[4] attributed the presence of phosphorus in the deposit to the autothermal redox reaction of hypophosphorous anion, yielding phosphorous anion, water and elemental phosphorus, the free energy of this postulation being about $\triangle F_{25} = - \sim 10$ K cal/M

$$2[H_2PO_2]^- \rightleftarrows H_2O + H^+ + [HPO_3]^{--} + P$$

This mechanism is improbable, because a low *p*H would tend to favor the reaction from right to left; while it has been shown that the phosphorus content of the deposits becomes lower as the *p*H increases.

Wurtz has claimed that hypophosphorous acid is reduced to phosphine by nascent hydrogen. This statement was later contradicted (although it was found to be true for phosphorus acid).

No phosphine could be detected in the gases evolved during chemical nickel plating, using the most careful analytical methods.

It is, therefore, suggested that the hypophosphite anion is reduced by atomic hydrogen (adsorbed on the catalytic surface) yielding elemental phosphorus, water and hydroxyl ion according to the equation:

$$[H_2PO_2]^- + H(Cat.) \longrightarrow H_2O + OH^- + P \quad (X)$$

The elemental phosphorus is immediately bonded to (or dissolved in) the nickel, making the reaction irreversible.

Because hydroxyl ions are produced, a low *p*H favors a high phosphorus content, which is consistent with the observed facts. *(To be continued)*

REFERENCES

[1]Brenner, A., and G. Riddell, Jrnl. of Res. of the Nat'l. Bureau of Standards, 1946, **37,** RP 1725.

[2]Brenner, A., and G. Riddell, Jrnl. of Res. of the Nat'l. Bureau of Standards, 1947, **39,** RP 1835.

[3]Ephraim, F., Inorganic Chemistry, 5th Ed., Interscience Publishers, Inc., New York, 1949. Remy, H., Treatise on Inorganic Chemistry, Elsevier Publishing Co., New York, 1956. Sidgwick, N. V., The Chemical Elements and Their Compounds, Oxford University Press, 1952. van Wazer, J. R., Phosphorous and Its Compounds, Vol. 1, Interscience Publishers, New York, 1958.

[4]Scholder, R., and H. Heckel, Z. f. anorg. und allgem. Chem., 1931, **198,** 329. Scholder, R., and H. L. Haken, Ber., 1931, **64,** 2870.

[5]Bach, A., Ber., 1909, **42,** 4463.

[6]Sieverts, A., Ztsch. anorg. und allgem. Chem., 1919, **64,** 29 and 60.

[7]Wieland, H., and A. Winkler, Ann., 1923, **434,** 198.

[8]Franke, W., and J. Moench, Ann., 1942, **550,** 1.

[9]Wurtz, A., C. R. Acad. des Sciences, April 15, 1844, **18,** 702 and A. Wurtz, Ann. Chim. Phys. 3, 1846, ser. **16,** 198 and 204.

[10]Breteau, P., Mem. Soc. Chim. **89,** 1911.

[11]Paal, C., and L. Frederici, Ber., 1931, **64,** 1767.

[12]U. S. Patent 1,207,218 to F. A. Roux, December 1916.

[13]Garbunov, K. M., and A. A. Nikiforov, Academy of Sciences, Institute of Physical Chemistry, Moscow, USSR, Sept., 1953.

[14]U. S. Patent 2,822,293 to G. Gutzeit, P. Talmey and W. G. Lee, Feb., 1958 (Filed Dec. 31, 1954), Assignor GATC.

[15]Goldenstein, A. W., W. Rostoker, F. Schossberger and G., Gutzeit, Jrnl. of the Electrochemical Society **104,** No. 2, Feb., 1957.

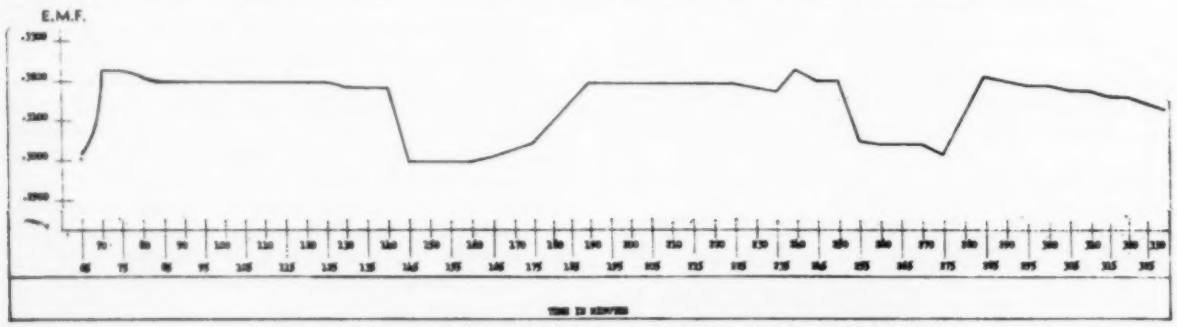

Fig. 6. Potential measurements of chemical nickel stripped in fuming HNO_3.

FILTRATION OF ELECTROPLATING SOLUTIONS

by ROCKWELL M. GRAY JR.

The types of pressure filters most often found in the filtration of electroplating solutions are presented. A brief discussion of the advantages and operating characteristics of each type is included. In addition, a discussion of the general conditions of pressure filtration with the emphasis on practical steps necessary to improve filter performance is undertaken. Tables are included showing flow rates for various plating baths and describing the filter types covered.

THE SELECTION OF FILTRATION equipment, used for the periodic or continuous removal of undissolved solids from a plating bath, provides a wide variety of alternates for the prospective buyer. The alternates range from different types of filters to identical type filters offering a choice of filter media. Each filter as well as the various filter media offer certain characteristic advantages when properly applied; but in virtually every case, there are limiting factors. A filter type, properly selected, employing the best filter medium for the application, properly installed, intelligently operated and given efficient maintenance can provide service and savings well above the level required for economic operation and initial investment write-off. On the other hand, failure to consider the above factors in the light of the intended application's requirements may result in an operation history of excessive costs and poor performance.

The cost of filtration is a function of the time and labor involved, the floor space and equipment required and the frequency of filtration desired. This cost must be related to the probable cost which will result in inferior work which may result from the presence of undissolved solids in the plating bath. These factors differ from one type of bath to another as well as on the same bath processing different types of work.

WHICH FILTER?

In considering which filter type is best suited for any type of application, the frequency of filtration must first be determined. If continuous filtration is required (i.e., filtration whenever work is being processed) the type filter and the filtration area are indicated by the total volume of solution involved, the type bath, and the turnover of the bath required to insure effective filtration. If batch or intermittant filtration is to be employed, particularly if used in conjunction with chemical treatment of the bath for the removal of organic contamination, the operation characteristics of the filter are entirely different and determine the type and size filter required. However, a filter which is of sufficient capacity to handle given solution volume after batch treatment with carbon will normally have enough capacity for continuous filtration.

Any filter worthy of the name will remove suspended matter from a solution and the degree of clarity possible is determined by the filter medium employed. The filter types most often encountered in plating bath applications are as follows:

I. TUBULAR TYPES
  A. Horizontally Suspended—Fig. 1.
    1. Solids retained within the tube
  B. Vertically Suspended—Fig. 2.
    1. Solids build up on the outside of the tube

II. CARTRIDGE TYPES—Fig. 3.
  A. Reusable elements
  B. Throw-away elements

III. HORIZONTAL PLATE TYPES—Fig. 4.

IV. VERTICAL LEAF TYPES
  A. Top outlet leaves—Fig. 5.
  B. Bottom outlet leaves—Fig. 6.

Table I compares the various type filters with regard to the different operating characteristics which are normally considered in their selection for plating applications. The term "HEEL" in Table I is defined as that volume of solution remaining in the filter chamber at the end of the filter cycle. The term "CAKE" in Table I refers to the accumulated suspended matter retained on the filter media during the filter cycle and the expression "BLOW DOWN" refers to the operation of introducing compressed air or gas to the filter chamber to evacuate the chamber at the end of the filter cycle as used in several of the filter types described.

Typical examples of the filter types described in Table I are shown in Figs. 1 through 6. Differences in design details within the general types exist between various manufacturers but Figs. 1 through 6 show the major features accepted as typical for the type filter illustrated.

HOW DOES A FILTER, FILTER?

Proper selection of the filter type and of the proper filter medium for any specific application entails at least a minimum knowledge of how the filter performs its liquid-solid separation. Solution is pumped to the filter and passes through the filter medium which has a certain porosity or particle retentivity. The porosity of the filter with regards to its initial retentivity may be closely controlled by selecting one of the many varieties of filter media available. In addition, the

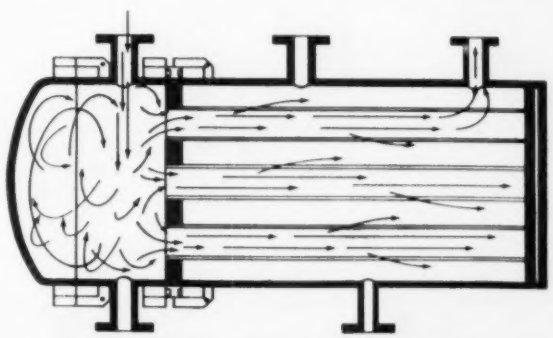

Fig. 1. Tubular filter, element horizontally suspended.

*Industrial Filter & Pump Mfg. Co., Inc., Chicago, Illinois.

TABLE I

FILTER TYPE	ELEMENT	FILTER MEDIA NORMALLY EMPLOYED	METHODS OF CLEANING NORMALLY EMPLOYED	OPERATING CHARACTERISTICS
I - Tubular	A.- Horizontally suspended	Paper, sintered metal, fine mesh wire cloth.	Filter blown dry with compressed air, filter media replaced or flushed off, unit reassembled.	All liquid filtered, no unfiltered "heel" - solids recovery possible - limited "cake" capacity - usually employed on low volume baths having small amounts of suspended matter, intermittant operation possible.
	B.- Vertically suspended	Textile cloth, porous stone, fine mesh wire cloth, sintered metal.	Tubes are backwashed with filtered liquid or water to dislodge cake. No disassembly of filter required except for cloth replacement and/or tube replacement.	Continuous filtration usually required, unfiltered "heel" equal to chamber volume sent to drain on cleaning, some filtered solution normally lost when cleaned, "cake" capacity may be quite large depending on tube spacing - disassembly for tube replacement may be difficult and time consuming.
II- Cartridge	A.- Reusable elements	Paper, resin impregnated non-woven fabrics, sintered metal.	Filter chamber drained, element removed, washed off & replaced, unit reassembled.	Filter area usually limited, little or no unfiltered "heel", limited "cake" capacity - intermittant operation may be satisfactory, life of element determines operating cost.
	B.- Throw-away elements	Paper, wound yarn cylinders, glass.	Unit drained, element throw away, new element inserted, unit reassembled.	Limited cake capacity, down time for cleaning on multiple units quite long, element replacement costs may be very high.
III- Horizontal plate		Paper, textile cloth, fine mesh wire cloth.	Unit opened, entire plate assembly withdrawn, plates separated, cleaned, assembly rearranged & replaced in chamber.	Excellent for intermittant operations requiring small "cake" capacity - each filter element uses only top side for filtering therefore filter area per given chamber size is low. No unfiltered "heel" - cleaning procedure requires considerable time & labor. Complete spare plate assemblies for each filter required to reduce filter down time.
IV - Vertical leaf	A.- Top outlet leaves	Paper, textile cloth, fine mesh wire cloth.	Air agitation and/or internal sluices discharge "cake", then sent to drain or unit may be opened and cleaned.	Filter area & "cake" capacity quite flexible depending on spacing of leaves, intermittant operation possible but recirculation to rebuild "cake" on vertical leaves may be required. Unfiltered "heel" equal to filter chamber volume sent to drain when cleaned. Repeated cleanings without opening filter are possible. Down-time when disassembled for filter media replacement periodically is required.
	B.- Bottom outlet leaves	Paper, textile cloth, fine mesh wire cloth.	As above or filter may be blown down with compressed air, "cake" blown dry & discharged automatically in dry state.	As in (A) above except unfiltered heel is greatly reduced and may be sent back to tank since cake is held on leaves during blow down operation. Automatic semi-dry cake discharge possible. Entire filter cycle may be automated, including blow down & cleaning.

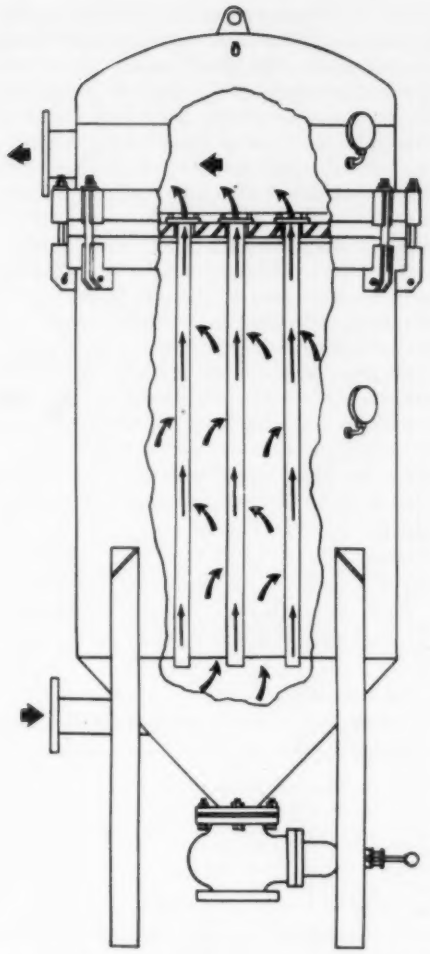

Fig. 2. Tubular filter, element vertically suspended.

porosity may be controlled by precoating the filter medium with a filter aid material which then acts as the filter medium and the basic filter medium such as paper, cloth, wire cloth, etc. then merely acts as the filter aid retainer. However, as solution passes through the filter medium, suspended matter starts to build up in the form of a filter cake, and as more and more solids accumulate in the form of a cake the degree of clarity becomes finer due to the sporadic distribution of fine solids across the face of the cake. The porosity of the cake decreases, the resistance to flow increases and the flow rate starts to drop off as the pressure drop across the filter cake increases. Presuming the pressure drop across the cake does not cause a breakthrough in the filter medium, this interplay of increasing pressure and decreasing flow rate continues until the flow rate drops off completely.

Practically speaking, the filter cycle or the available total throughout in gallons per square foot of filter area is inversely proportional to the percentage of solids in the solution being filtered and further, by the nature of these solids themselves. If the solids are crystalline or granular in nature (i.e., do not deform easily under pressure) the resultant filter cake will remain relatively free-flowing and a cake of finite depth, (perhaps one-half inch up to two or three inches) can be built up over the filter medium before the cake resistance reaches the point where no flow or very little flow results. On the other hand, should the solids be of a gelatinous nature, easily deformed by pressure across the cake, then a very thin cake, (perhaps in the range of one-sixteenth of an inch or less) may be the limit before a "no flow" condition is reached.

Closely related to cake compressibility is flow rate per unit filter area since lower flow rates per unit area allow the cake to build up easily, each solid colliding with the cake at a lower velocity, keeping the deformation with its consequent blinding of the cake pores to a minimum.

In the filtration of plating solutions, we have solids introduced to the plating bath from a variety of sources with the expected result being a mixture of both crystalline and gelatinous solids. Airborne dust and dirt, anode sludge, chemical precipitates, dirt on the work being processed, and collodial solutions from tank linings and other organic materials are the primary sources of suspended matter. Because of the

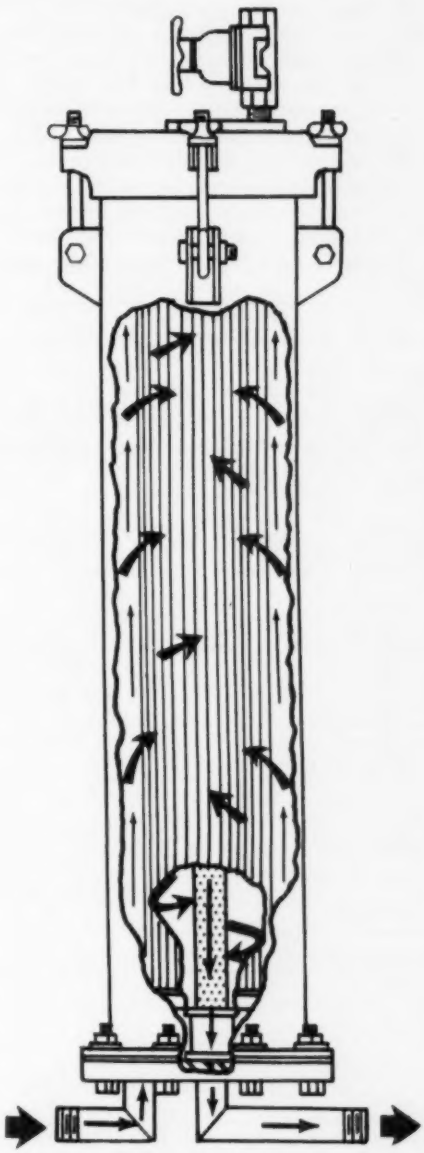

Fig. 3. Cartridge filter.

many variables involved, selection of a particular filter medium with or without precoat, is usually determined by accepting a reasonable compromise between ideal filter performance and initial cost and operating expense. For example, filter paper is available, as are fabrics and wire cloths, which will give extremely fine clarity without filter aid precoat. However, the porosity of these media is so low that rapid blinding, high pressure drop, and short cycles can be expected. This may be very satisfactory on a small filter used on a precious metal bath of very low volume in which the solids introduced to the bath from the various sources are light in comparison to the solution volume. Reasonably long filter cycles without the extra problems encountered in handling filter aid, with a relatively low filter operating cost could be expected on a bath of this type. On the other hand, a 10,000-gallon cyanide copper solution handled on the same filter medium without benefit of filter aid (on one or more large filters) would result in an operating cost well out of line due to short cycles and frequent filter media replacement.

Assuming continuous filtration is required for a particular application, based on a solution turnover rate of one tank volume per hour, Table II shows the average flow rate (in gallons per hour per square foot of filter media) for the more common plating solutions as well as the materials of construction for the filter, type filter media and piping which will give the best service. The term average flow rate, as shown in Table II, represents an average rate of flow over the filter cycle and in actual practice may be held higher by more frequent cleanings of the filter or reduced by less frequent cleaning procedures. With regard to pumping equipment, pumps compatible with the type piping required (i.e., cast iron for unlined steel and rubber lined pumps for rubber lined pipe) are usually furnished. The filter media listed in Table II assume filter aid material is used, which is the general practice in virtually all continuous filtering installations and the materials recommended are by no means the only suitable types. Fine mesh wire cloths, porous stones and other media may be substituted for the textile cloths where corrosion resistance and filter type requires substitution.

The subject of which filter medium is best for any particular application is a matter requiring serious consideration but one which is in itself too involved for discussion at this time. However, particularly where filter aid material is to be used, a filter medium which will retain the precoat of filter aid and will provide ready cake release when cleaned, especially in the case of repeated cleanings over many cycles of the filter without the interstices of the medium becoming blinded, is the ideal material. For example, fine mesh wire cloth leaves in vertical leaf filters—despite their higher initial cost—have proved to be very economical in many applications. This has proved true in applications where the nature of the solution permitted construction of the leaves in expensive alloys such as stainless steel, Hastelloy and monel and consequently the repetitive costs for textile cloth or paper replacement, as well as the downtime involved in their replacement were eliminated.

Proper type and grade of filter aid, and amount of filter aid dosage per square foot of filter area must be maintained to insure satisfactory results. As in the case of selection of filter

TABLE II

TYPE SOLUTION	AVER. FLOW RATE GALS/HR/SQ. FT.	MATERIALS OF CONSTRUCTION	
		FILTER CHAMBER & INTERNALS & PIPING	FILTER MEDIA
Electro – less nickel	20	Rubber lined	Nylon cloth
Copper sulfate	30	Rubber lined	Orlon cloth
Copper fluoborate	30	Rubber lined	Orlon cloth or Dynel cloth
Pyro Phospate	30	Rubber lined	Nylon cloth or Dynel cloth
Copper cyanide (proprietory)	20	Steel	Nylon cloth or Dynel cloth
Brass cyanide	20	Steel	Nylon cloth or Dynel cloth
Watts Nickel	30	Rubber lined	Nylon cloth or Orlon cloth
Nickel (chloride 12 oz) (per gal. or higher)	30	Rubber lined	Orlon cloth
Nickel sulfamite	30	Rubber lined	Nylon cloth
Nickel fluoborate	30	Rubber lined	Orlon cloth
Tin alkaline	20–25	Steel	Nylon cloth
Tin fluoborate	15	Rubber lined	Orlon cloth or Dynel cloth
Zinc cyanide	20–25	Steel	Nylon cloth
Zinc acid	15	Rubber lined	Nylon cloth
Brass fluoborate	25	Rubber lined	Orlon cloth
Cadmium cyanide	25	Steel	Nylon cloth
Chromium	20	Poly Vinyl Chloride	Orlon cloth
Gold or Silver cyanide	25	Rubber lined	Nylon cloth

media, the subject of filter aid selection (type, grade used, recommended dosage per square foot of filter area, etc.) is too detailed for proper coverage in this paper. In passing however, it is well to point out that in certain applications—particularly those in which the suspended matter is gelatinous and of relatively high percentage compared to the solution volume being filtered—significant improvement in the total throughput of the filter may be achieved by the continuous addition of filter aid during the filter cycle. The filter aid so introduced will keep the filter cake more porous and free flowing,greatly extending the throughput. A slurry of clean solution (or water if the bath in question will allow it) and filter aid is prepared and fed to the filter by means of a metering pump or other suitable feeder during the filtering cycle. The rate of feed of the filter aid slurry is adjusted to introduce one part per million of filter aid for each part per million of suspended matter estimated to be in the solution being filtered. One point must be firmly established in the employment of a continuous filter aid addition and that is the total cubic capacity of the filter in terms of cake space. Since the cake may remain porous and free flowing it is entirely possible that the cake build-up may reach the point where the available space in the filter is completely exhausted before the pressure build-up or drop-off in rate of flow so indicate. At best, this may severely complicate cleaning of the filter and in extreme conditions may lead to physical damage within the filter chamber itself.

GENERAL OPERATING CONSIDERATIONS

In many instances, after a careful evaluation of the many factors required in selecting a particular filter for a certain application the filter selected fails to perform to expectations. By far, the majority of cases where this is true is directly caused by failure to observe sound engineering practices in the location, piping, and operation of the equipment.

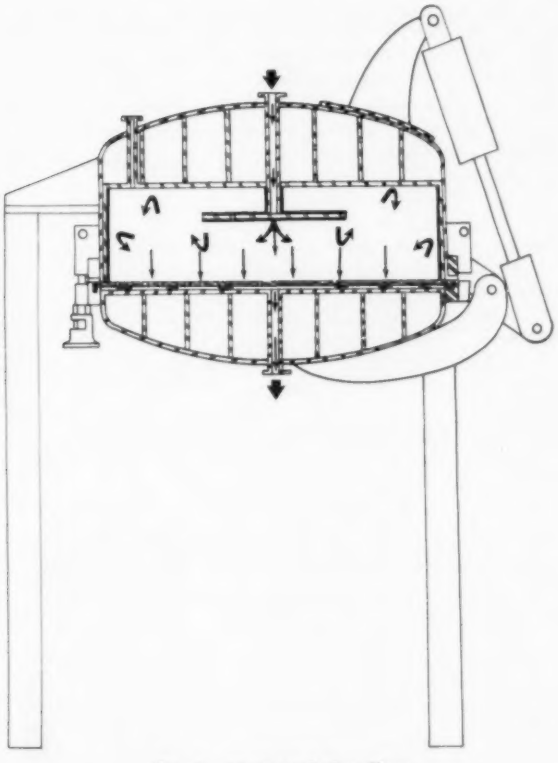

Fig. 4. Horizontal plate filter.

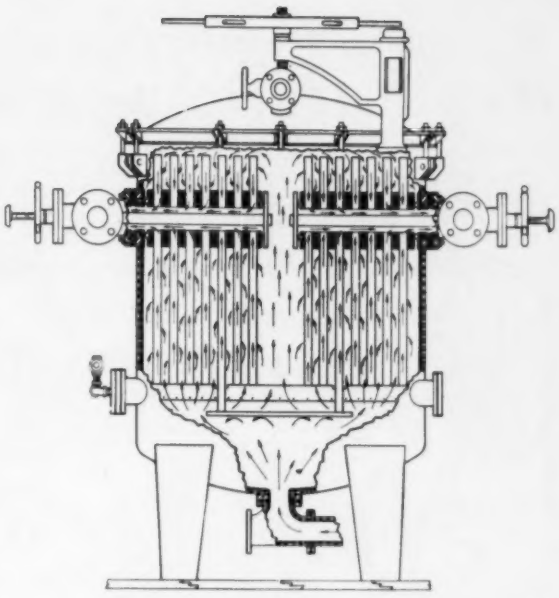

Fig. 5. Vertical leaf filter, top outlet type.

The ideal location is directly adjacent to the tank or tanks from which the filter pump is taking suction. Floor space is always at a premium, particularly adjacent to the plating machine or tank, but proper preplanning or careful rearrangement of the plating room layout can often make the difference between a satisfactory operation and a dismal failure. Excessive suction lifts, runs of suction or return lines 50 or 60 feet in length, inadequate pipe size, undersize pumps and other seemingly obvious points are many times the real cause of inadequate filtration. If the plating room layout prevents location adjacent to the solution tank, at least within 15 feet, then oversize piping and larger pumps than would seem otherwise necessary should be used. Nearby floor drains, ready access to the valves necessary to operate the filter, ample space for whatever disassembly may be required to keep the filter in operating condition are all factors which should receive careful prestudy. In many cases, floor space limitations will dictate the selection of a filter type in order for proper operation and the resultant savings in good performance and ease of maintenance will more than offset the additional cost, if any, in purchase of the type filter required to meet floor space limitations.

Proper location with adequate piping and pumping equipment will do much to insure proper filter performance. In addition, proper location of suction and return lines to the plating tank itself are of extreme importance. Improper circulation patterns within the plating tank often lead to continued recirculation of small percentage of the total solution volume, allowing other parts of the solution to remain, accumulating suspended matter. A general thumb rule is to take suction at as low a level in the tank as is possible and to have the suction points at the exit end of work travel in the tank. The return line to the tank should return solution at the end of the tank opposite to the suction and at as high a point with relation to the solution level as is practicable. Ideally speaking, a series of suction lines, manifolded together, with multiple return points in the tank will insure adequate cir-

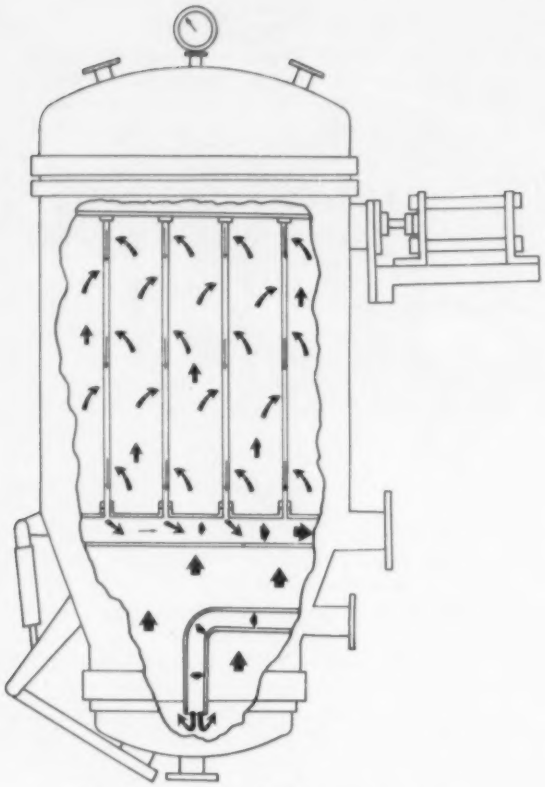

Fig. 6. Vertical leaf filter, bottom outlet type.

culation patterns, thereby putting the largest percentage of the total solution through the filter system.

Odd shaped tanks, tanks with diaphragm systems and tanks with discharge headers designed to provide solution agitation all require extra care and planning to insure proper circulation patterns. The increasing number of air agitated baths prompts a word of caution with placement of suction connections in these tanks. Insure that the suction points are well below the air agitation grid or entrapped air will be forced into the pump and filter system and may cause poor filter operation, excessive foaming and other troubles associated with air leaks.

Establishing a definite filter cycle is another point which is often overlooked, yet there is an optimum cleaning point for each and every filter installation. Operating experience will show that at some particular pressure the flow rate through the filter will start to decrease.

Once the drop-off point in the filter is reached, although filtered solution is still being produced, the rate of turnover decreases so rapidly and pressure builds up so fast that it is rarely worth the cost of the horsepower expended to pump at these higher pressures. Rate of turnover is so low at these pressures, that suspended solids introduced to the bath will build up faster than the filter will remove them and solution clarity will deteriorate, making the load on the filter much heavier on the next cycle. The time in hours or days before this point will be reached is proportional of course to the factors previously discussed, namely, flow rate per unit area, percentage of suspended solids, nature of suspended solids, etc. The time may be extended through the continuous addition of filter aid as discussed above although the cubic capacity of the filter and the operating cost must be carefully calculated to insure the advantages gained are economical. Once the optimum cleaning point is established for a filter, (usually correlated to a pressure on the filter chamber) strict adherence to a cleaning schedule at that point should be practiced.

Although not directly related to filter performance, the arrangement of external heat exchangers in the same circulation system as the filters is occasionally contemplated. Since the flow rate through an external heat exchanger is one of the factors which determine its size and cost, it is often necessary to buy larger heat exchangers than is required in order to meet flow rate restrictions encountered in the filter system. In addition, to be flexible in operations, by-pass connections around both the filters and heat exchangers are required so that in the event of a mechanical failure in either, flow through the other may be maintained. By the time the cost of the by-pass system is calculated, including the additions for larger size heat exchangers or filters which may be required, separate systems each with its own circulating pump often proves most economical. The added flexibility in operations using separate heat exchangers and filter systems is in itself often worth far more than any savings which are possible in a series operation on one system.

If a series operation is a necessity, despite the above noted disadvantages, then the best arrangement is to have the heat exchanger on the discharge or filtered solution side of the filter. The primary reason for this arrangement is to keep the operating temperature in the filter as low as possible while having the heat exchanger discharge as close to the plating tank as possible. However, it is felt that a heat exchanger connected in series with a filter is a poor operating practice and should be avoided.

The above discussion has been limited to the more practical aspects of filter selection, filter theory and operating procedures which should insure the best possible operation and economy when considering new equipment or in operating existing equipment. None of the points discussed are intended to mitigate the time honored necessities of preventive maintenance, well trained personnel and good operating practices in the plating room. A properly selected filter wisely operated and given good care will provide years of satisfactory service towards the production of high quality electroplated work.

REFERENCES

[1]Grace, H. P., "Art and Science of Liquid Filtration" A.I.Ch.E. 50th Anniversary Meeting, Philadelphia, June 1958.

[2]Gabrielson, G., Metal Finishing **55,** 50–1 (1957).

[3]Zievers, J. F., R. W. Crain, and W. L. Werchun, Industrial and Engineering Chemistry **53,** 493–6 (1957).

[4]Products Finishing **20,** 28–32 (May 8, 1956).

[5]Electroplating Engineering Handbook, A. Kenneth Graham, 1955.

[6]Hoffing, E. and F. Lockhart, Resistance to Filtration-Chemical Engineering Processing Vol. 47 No. 1.

[7]Ruth, B. F., Correlating Filtration Theory with Industrial Practice, Industrial and Engineering Chemistry, June 1946.

Rockwell M. Gray Jr. is a graduate of the U. S. Naval Academy, Annapolis, Md., 1950. After graduation he spent six years active duty as an aviator, then joined the sales engineering staff of Industrial Filter and Pump Mfg. Co., Inc., Chicago, Illinois. He is a member of the American Electroplaters' Society.

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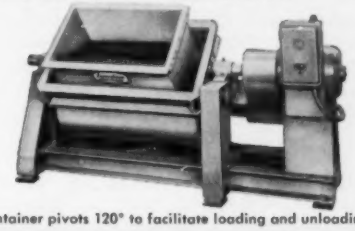

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CHECK SHEET FOR MOTION ANALYSIS, USING M-T-M SYMBOLS

by **JOHN R. HEIZMANN***

METAL POLISHING is usually regarded as an art, rather than as a science, not only because of the variety of conditions under which the work is performed, but also because it is commonly found that two polishers who are polishing the same type of object and working with same type of equipment will often employ different techniques (motions) to finish the work. This latter fact coupled with the rapidity of the individual motions is sometimes found to be as a stumbling block to time and motion study personnel.

In the polishing department of a manufacturer of plumbing fixtures, Dick Brothers, Inc., of Reading, Pennsylvania, this problem was surmounted by employing a check list, using pertinent M-T-M Symbols across the top of the page. A preliminary check of the polishing techniques disclosed that all of the polishers' motions could be identified by a limited number of M-T-M symbols. These symbols were next entered on sheets of lined paper. Then stop watch time studies were preceded by motion analysis in which these sheets were used as check lists.

After a motion analysis was made in this manner, each group of checks corresponding to a complete time study element was encircled, and marked with a number corresponding to the element on the time study itself. Later, the details of each element were written on the check sheet to the right of the motion analysis. (See Fig. 1).

These motion analyses were later studied for unnecessary and duplicated motions, and were then used as aids in leveling the stop watch time studies to which each pertained. Job descriptions were then drawn up embodying the most efficient polishing technique which had been extracted from these M-T-M motion analyses.

*Consultant, Pottstown, Pa.

John R. Heizmann is a 1937 graduate of the University of Detroit. He also holds a diploma in Ferrous Metallurgy from Penn State University and one in Industrial Engineering from the Industrial Management Institute of Reading and Philadelphia, Pa. After several years as a metallurgist for Great Lakes Steel Corp., he joined Penn Hardware Co. of Reading, Pa. There he was employed for 13 years as an industrial engineer and a member of the executive committee. Three years were spent as an AAF Base metallurgist during World War II. For five years he owned and operated his own electroplating job shop in Reading. He subsequently has been a sales engineer with Frederic B. Stevens, Inc., and management consultant with George S. May Co.

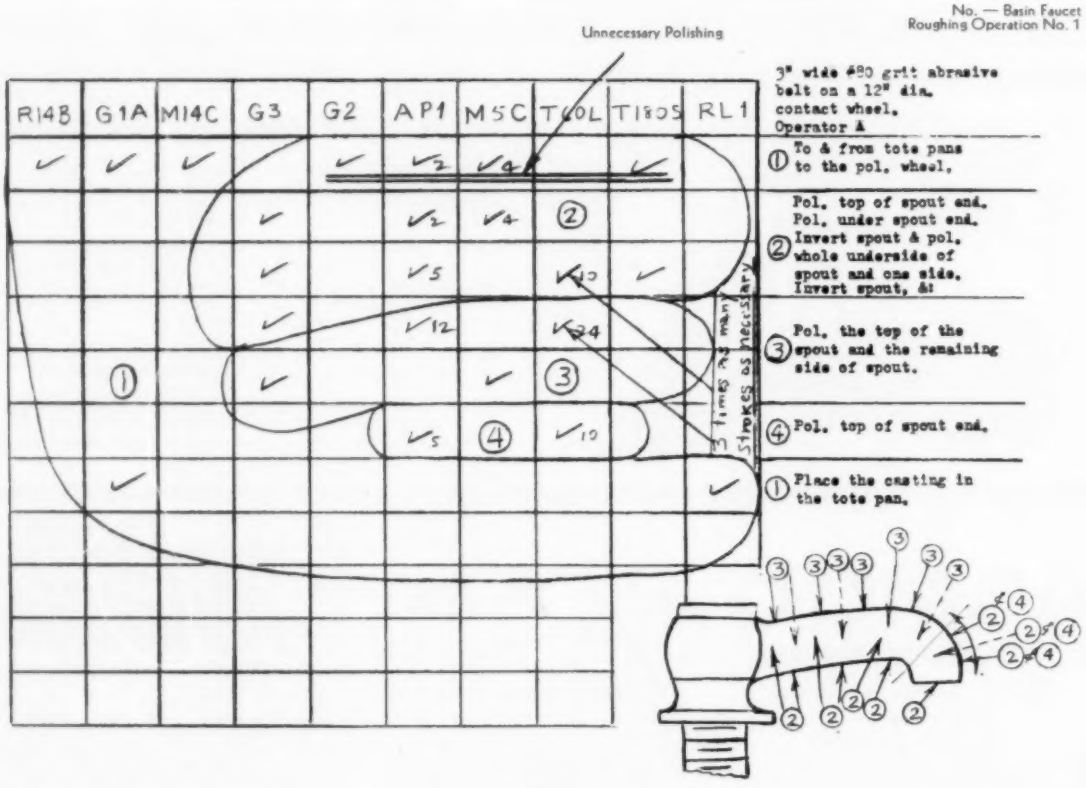
No. — Basin Faucet
Roughing Operation No. 1
Unnecessary Polishing
R14B
G1A
M14C
G3
G2
AP1
M5C
TOOL
TIBOS
RL1
3" wide 480 grit abrasive belt on a 12" dia. contact wheel. Operator A
① To & from tote pans to the pol. wheel.
② Pol. top of spout end. Pol. under spout end. Invert spout & pol. whole underside of spout and one side. Invert spout, &
③ Pol. the top of the spout and the remaining side of spout.
④ Pol. top of spout end.
① Place the casting in the tote pan.
3 times as many strokes as necessary

Fig. 1

No. — Basin Faucet
Roughing Operation No. 2

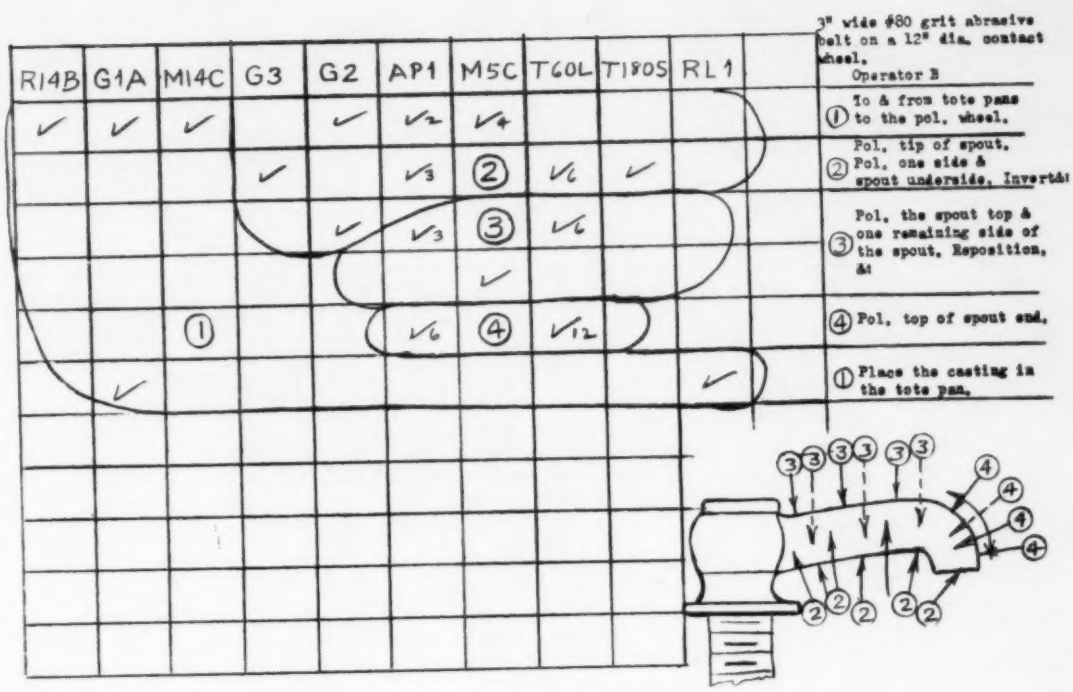
R14B
G1A
M14C
G3
G2
AP1
M5C
T60L
T180S
RL1
3" wide #80 grit abrasive belt on a 12" dia. contact wheel.
Operator B
① To & from tote pans to the pol. wheel.
② Pol, tip of spout, Pol, one side & spout underside, Invert&
③ Pol, the spout top & one remaining side of the spout, Reposition, &
④ Pol, top of spout end.
① Place the casting in the tote pan.

Fig. 2

No. — Combination Body
Cutting Down Operations 1 and 2

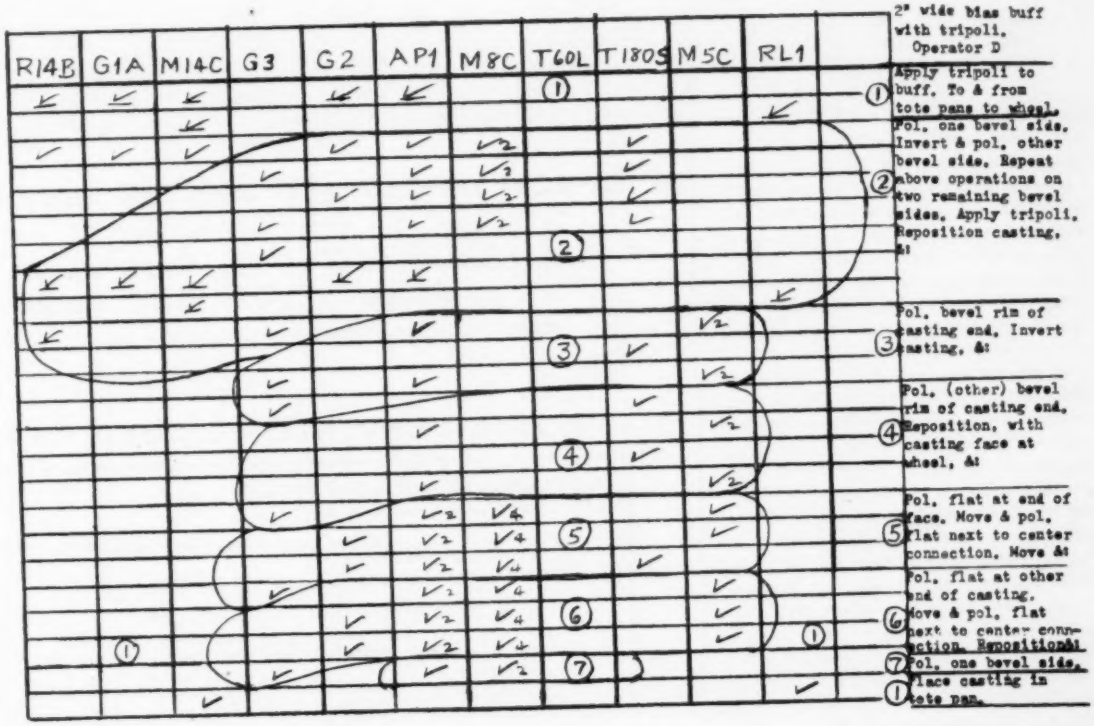
R14B
G1A
M14C
G3
G2
AP1
M8C
T60L
T180S
M5C
RL1
2" wide bias buff with tripoli.
Operator D
① Apply tripoli to buff. To & from tote pans to wheel, Pol, one bevel side, Invert & pol, other bevel side. Repeat
② above operations on two remaining bevel sides. Apply tripoli, Reposition casting, &
③ Pol, bevel rim of casting end, Invert casting, &
④ Pol, (other) bevel rim of casting end, Reposition, with casting face at wheel, &
⑤ Pol, flat at end of face. Move & pol, flat next to center connection. Move &
⑥ Pol, flat at other end of casting. Move & pol, flat next to center connection. Repositions&
⑦ Pol, one bevel side, ① Place casting in tote pan.

Fig. 3

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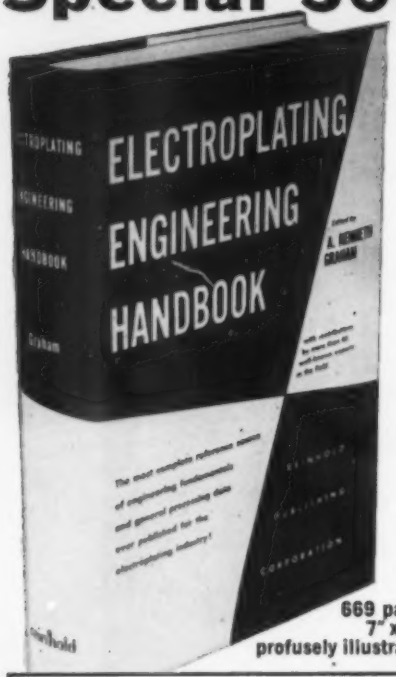

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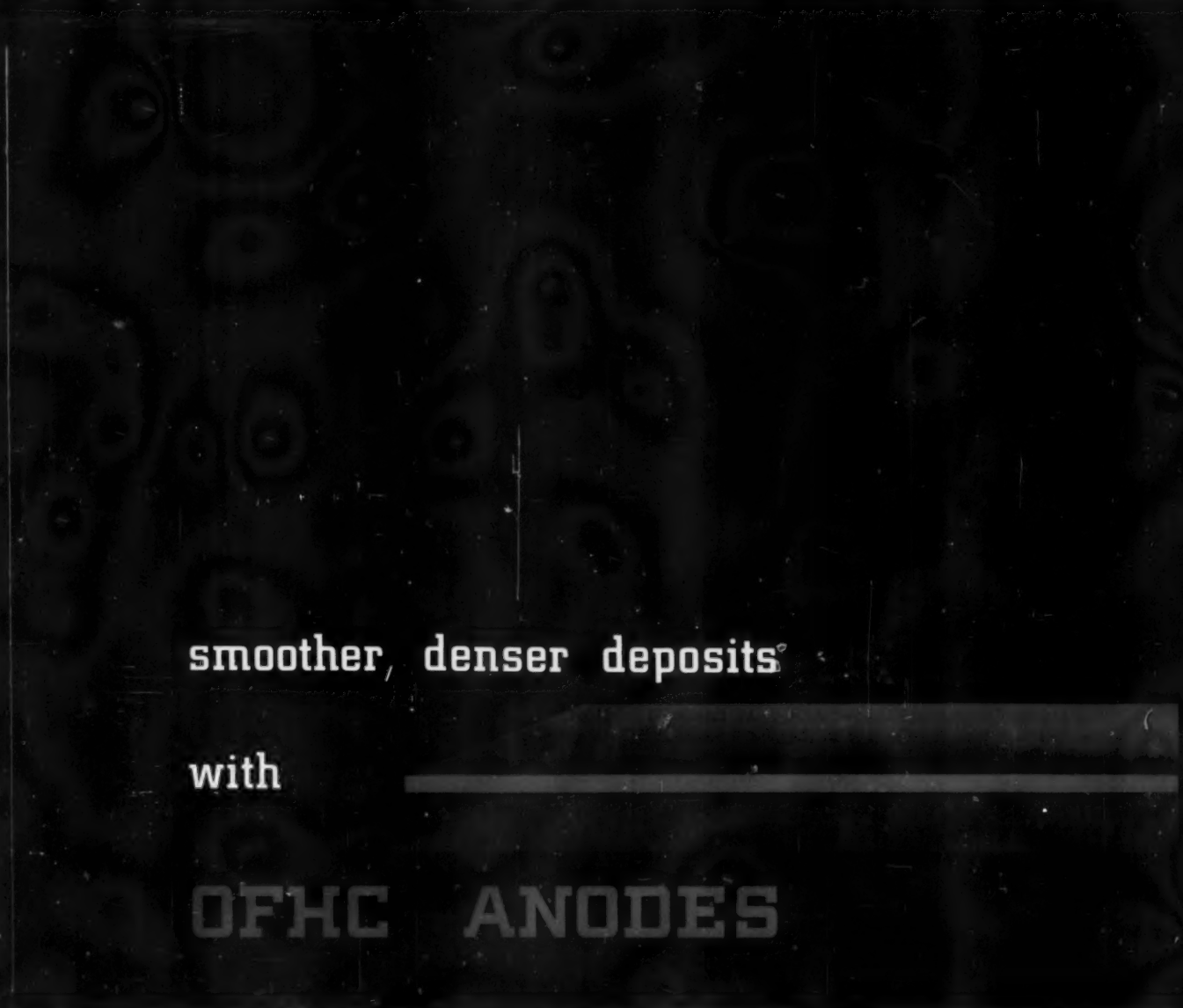

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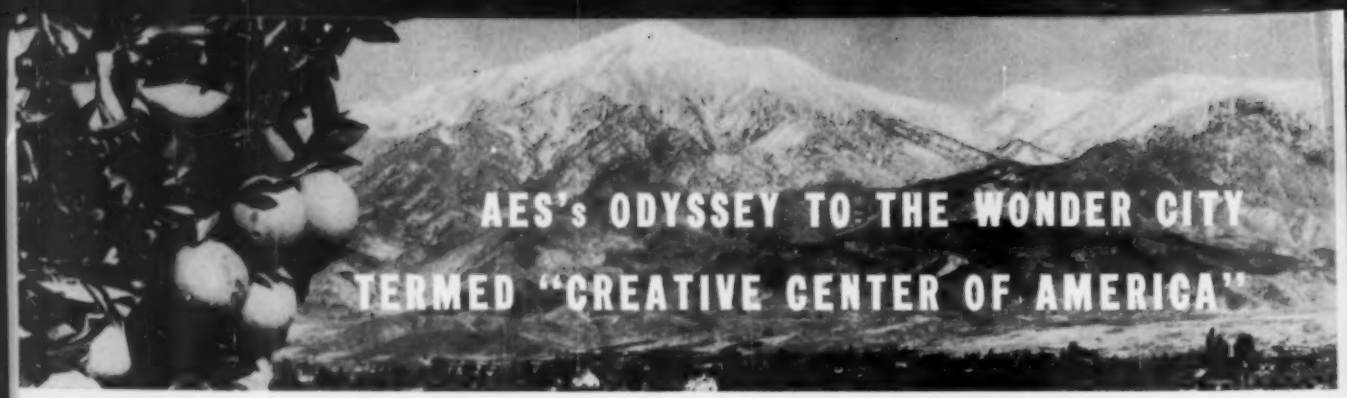


AES's ODYSSEY TO THE WONDER CITY TERMED "CREATIVE CENTER OF AMERICA"

MODERN Los Angeles, locale of the 47th Annual Convention of the American Electroplaters' Society (AES) July 24–28, 1960, is a city bulging with muscle—vibrating with confidence and enthusiasm—always looking ahead to things that must be accomplished in the future. There has been no more phenomenal and sustained industrial, commercial and population growth in any area of the United States than that which has occurred in the last few decades in the City and County of Los Angeles. Apart from the technical and scientific knowledge, and the fellowship and fun, to be gained at AES's dynamic Los Angeles Convention, what will AES members and their families find in the Golden City beyond the Rockies?

DULL MOMENTS SCARCE IN WONDER CITY

AES's Conventioneers in this amazing metropolis will not be at a loss during "off duty" hours for something interesting to do or some important place to go for amusement, for enlightenment or for ordinary sightseeing.

Glamorous Hollywood is indeed a sight to behold. And high too on the list of things to do in Los Angeles is a visit to one of the major radio or television studios, with attendance at one or more broadcasts. Many of the nation's top programs originate in Los Angeles.

There are many points of historical interest and scenic beauty, moreover, that enhance the attractiveness of Los Angeles. There is Olvera Street, a bit of Old Mexico with curio shops and cafes. Chinatown, with its quaint shops, lily pools and courts, offers silks, antiques, jewelry and scores of other souvenirs for purchase. Grauman's Chinese Theater, a landmark of Hollywood Boulevard, is famous for its courtyard, in which appear the hand and foot prints of movie stars, past and present. And those interested in the astral variety of stars will find the Griffith Park Observatory of special interest.

Other scenic attractions include the San Fernando Valley with its "outdoor life" homes and suburban gardens—Santa Catalina Island renowned for its submarine gardens and Mediterranean atmosphere—the world-famous Los Angeles and Long Beach Harbors—the impressive Palisades overlooking the beach at Santa Monica.

MOON TRIPS AND OCEAN TREASURES

Children everywhere have been thrilled by fabulous Disneyland. This versatile fairyland in concrete and steel brings to life legendary characters and even provides everyone, adults and youngsters alike, with the opportunity to journey by simulated rocket to the imaginary moon.

The Old West and the days of the '49ers live again in the authentic atmosphere of Knott's Berry Farm and Ghost Town. What was begun in 1920 as a small berry shed has become today a nationally recognized "must" as a tourist attraction.

Jules Verne's undersea world comes into sharp focus at the new Marineland Aquarium, the world's largest Oceanarium. Visitors by the thousands flock to this magnificent creation of modern science, where every conceivable type of ocean habitat has been duplicated.

WONDER CITY: ITS MEANING INDUSTRIALLY

In addition to its high vacationland attraction, Los Angeles County has grown industrially, keeping pace with its phenomenal population growth. Los Angeles County's diversified industrial might was depicted in an industrial survey released early in 1957 by the Los Angeles Chamber of Commerce. This survey showed that the aviation industry led a field of 19 major industries in capital investment during 1956, with $76,176,000 invested in new plants and expansions.

Los Angeles' automotive industry ranked second in 1956 according to that survey with a capital investment of $40,875,500. A total of $38,782,500 invested in the construction of new and expanded metal products firms catapulted the metal product industry to third place in the Chamber's statistical report. And so close to that figure as to all but result in a tie for third place was the rapidly expanding electronics industry, which boasted an investment of $38,765,000 in 24 new plants and 35 expanded facilities during 1956.

Chemicals and paints ranked fifth with a capital investment of $35,035,000 in 25 new and expanded plants. The petroleum products industry placed sixth with $26,860,500 invested in expanded facilities.

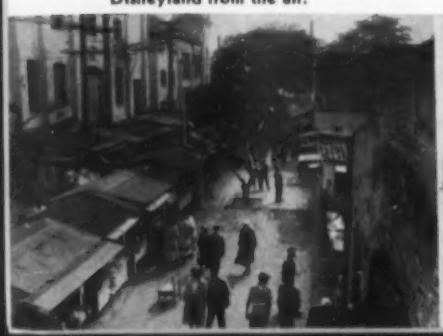
Leading the nation in the manufacture of aircraft and aircraft parts, pumps and compressors, refrigeration equipment and canned sea food, the Los Angeles Metropolitan area is second, nationally, in automobile tire and tube production and a host of other products including blown glass and jewelry.

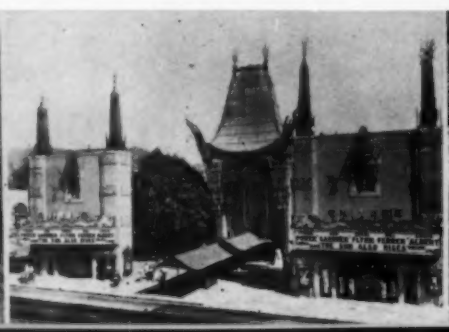
"CREATIVE CENTER OF AMERICA"

The unprecedented growth of such pioneering industries as electronics, instrumentation, research and development and other engineering activities has brought the title, "Creative Center of America" to Los Angeles. It earned that title by successful search for new ways to make better products.

Clearly, AES members and their families and guests who will cross country to be educationally and relaxationally enriched at AES's 47th Annual Convention, July 24–28, 1960, will have a "never-to-be-forgotten" odyssey in America's "Wonder City."

(Left) Olvera Street in Los Angeles is filled with picturesque shops and cafes. (Center) Grauman's Chinese Theatre in Hollywood, scene of the most glamorous movie premieres. Footprints and handprints of the great stars are imbedded in the sidewalk. (Right) Exciting Disneyland from the air.





AES NEWS

DALLAS-FORT WORTH BRANCH STAGING TWO-DAY "AEROSPACE FINISHING SYMPOSIUM"

A vaunted two-day "AEROSPACE FINISHING SYMPOSIUM" featuring a four-session educational program on "treatment and finishes for aerospace materials" is the educational fare being offered to the Southwestern area of the electroplating and metal finishing industry by the AES's dynamic Dallas-Fort Worth Branch in collaboration with the Society of Aircraft Materials and Process Engineers. The event will be held at the Texas Hotel in Fort Worth December 8–9, 1959.

On December 7, the day prior to the actual start of the educational sessions, it is tentatively being planned to conduct an organizational meeting of the proposed AES Southwestern Regional Group, expected to comprise the AES's Houston, Kansas City, Dallas-Fort Worth, Wichita and possibly the Society's new Denver and Phoenix Branches.

Targeted to an anticipated 500-person attendance, the two-day Symposium will embody morning and afternoon sessions on December 8 and 9, each covering one of four subjects, namely 1) Plating, 2) Special Processes and Treatments, 3) Organic Finishing and 4) Coatings for the Future. There will be four speakers per session plus two luncheon speakers. The actual program, now in process of development, will be announced in full in a subsequent issue of PLATING MAGAZINE.

The Symposium will conclude with a gala Banquet and Floor Show on December 9. Display booth areas and booths are being made available at nominal cost to suppliers wishing to exhibit equipment and processes on an educational basis.

The cooperating Society of Aircraft Materials and Process Engineers (SAMPE) was founded on the West Coast two or so years ago and, reportedly, has already expanded to some thousand members grouped in some ten or more Branches. All aircraft and missile companies are reportedly affiliated with SAMPE. That Society is collaborating fully with AES Branch President Myron E. Browning and his industrious AES Dallas-Fort Worth Branch "Symposium" Committee associates.

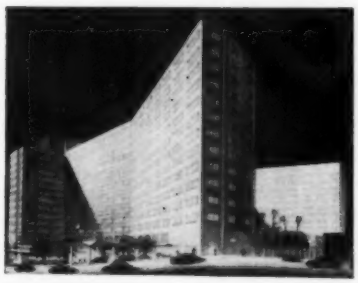
SEVENTH INTERIM MEETING SET FOR FEBRUARY 20, 1960

A half-century ago in 1960, AES's Philadelphia Branch was born as first offspring of the New York "Mother" Branch. And that historic Branch's Golden Anniversary will be commemorated in the Quaker City in 1960 not only by a fitting two-day Fiftieth Anniversary Educational Sessions and Banquet but also by the concurrent SEVENTH INTERIM MEETING of the Supreme Society for which the Branch will serve as Host.

To be held in Philadelphia's well-known Ben Franklin Hotel on February 19-20, 1960, the Philadelphia event will be a two-segment attraction expected to draw a large AES assembly to the Keystone City.

The Educational Sessions being programmed by Branch President James L. Cogan Jr. and his associates looms formidable and it will be seasoned by other appealing Fiftieth Anniversary attractions, including an Anniversary Banquet that Saturday evening.

The Supreme Society's Interim Meeting will be held Saturday, February 20 and is targeted for large attendance of Branch accredited Delegates from near and far. The Executive Board will meet during the full day Friday, February 19, and again on Sunday, February 21.



AES'S WEST COAST FAMILY OUTING

Aside from AES's thriving Los Angeles Branch that will host the AES's 47th Annual Convention, with the sumptuous Statler Hotel (above) of that community as Convention Headquarters, the Society is currently represented in our nation's western area by chartered AES Branches in San Francisco, Portland, Seattle-Puget Sound, British Columbia, Phoenix and Denver. These members of the AES's Western community are eagerly awaiting the arrival of the full AES body for a western Convention. The Society first immigrated into that western area with its Los Angeles Branch some three decades ago.

TREASURE CHEST OF KNOWLEDGE BEING READIED

Considerable progress has been made in the preparation of the Golden Jubilee Edition of the AES annual book, TECHNICAL PROCEEDINGS embodying not only each of the 43 technical papers by experts of nine countries presented before the AES's Fifth International Conference on Electrodeposition and Metal Finishing in Detroit, June 15–19, 1959 but also the transcript of the discussion that attended the delivery of each such paper.

By far the largest TECHNICAL PROCEEDINGS in the AES's half-century history, National Headquarters hopes to have that voluminous book, awaited internationally, published by late this Autumn. A copy will be issued to every AES member in good standing as at November 1, 1959. Extra copies will be sold to non-members on strictly a "first come-first served" basis so long as that limited extra quantity lasts.

Ben Franklin Hotel, site of the AES Seventh Interim Meeting and Philadelphia Branch Golden Anniversary Educational Session and Banquet.

IS ADVANCEMENT IN ELECTROPLATING AND METAL FINISHING IMPORTANT TO YOUR COMPANY'S FUTURE?

NEARLY a half-million dollars has been invested in AES Research in the last decade as an endowment for the continued progress of the electroplating and metal finishing industry. That cost has been borne not only by the Active Members and Members-at-Large of the AES by allocation thereto of a share of their annual membership fees in the Society but also by many companies like yours that, as Sustaining Members, have invested in expanding technical and scientific knowledge and techniques in electroplating, metal finishing and allied arts.

You as a company are most cordially invited to apply for Sustaining Membership in the American Electroplaters' Society thereby taking your place in this program by the side of so many other industrial concerns of your type in the United States and Canada. Cost to you is $100 per twelve-month period. Materially, you will also benefit as follows from your Sustaining Membership:

1. Your designated representative will enjoy all the privileges of Active Membership in the AES except voting and holding office.
2. He will receive, in your behalf, a subscription to PLATING, the official AES journal.
3. He will receive a copy of the bound book titled "TECHNICAL PROCEEDINGS" containing the technical papers presented at the year's Annual Convention.
4. He will receive quarterly reports on the status of the active individual research projects—reports prepared by the Vice Chairman for Research of the Research Committee. Practical hints gleaned from these reports may be worth to you, many times the cost of your Sustaining Membership.
5. He will receive paper-back bound copies of Serial Reports on specific results of research as they issue.
6. You will receive as a company, a Sustaining Membership plaque, set in clear plastic suitable for office display which identifies you as a sponsor of AES Research.
7. As a company, you will also receive periodic listing with other Sustaining Members in PLATING and in other AES publications as public recognition of your support.

As evidence of your company's interest in the significance of this program, you may, if you please, finance more than one such Sustaining Membership at $100 apiece per twelve-month period. Indeed, a number of companies are financing as many as five or more per year. In such case, please designate as many of your company executives to receive copies of the foregoing as the number of Sustaining Memberships that you finance.

An Application Blank will be sent promptly upon arrival of your request at National Headquarters. At the same time, you will receive a free copy of the booklet, "Is Advancement in Electroplating and Metal Finishing Important to YOUR Company's Future?"

AMERICAN ELECTROPLATERS' SOCIETY

445 BROAD STREET NEWARK 2, N. J.

GRAND RAPIDS LADIES NIGHT AT COUNTRY CLUB

The Grand Rapids Branch will follow its usual custom this year by making the regular October meeting night the Annual Ladies Night.

The Ladies Night festivities will be held on October 9 at the Green Ridge Country Club in Grand Rapids, Michigan, with dancing and refreshments between the hours of 8:30 p.m. and 12:30 a.m. At 1:00 a.m., an early morning breakfast will be served to culminate the activities. Constance Duin and her five-piece orchestra will provide the music.

TO ALL BRANCH SECRETARIES

1. **The list identifying and authenticating the Delegates/Alternates elected by your Branch for 1959-1960 tenure is due in the hands of the National Executive Secretary by not later than November 2, 1959. The official Return Sheet upon which to list your 1959-1960 Delegates/Alternates for accreditation by the Credentials Committee has already been sent to you. It requires signature of both the Branch President and Secretary.**

2. **The due-date of your Branch Per Capita Taxes at the new rate is October 1, 1959 for the fiscal year from July 1, 1959 through June 30, 1960.**

3. **Your Branch, via its accredited Delegates, has been invited to nominate any qualified member of the Society whom it chooses for consideration for the AES Scientific Achievement Award. Your choice must be supported by six copies of a statement of your nominee's qualifications. These are due in the hands of the National Executive Secretary by not later than October 15, 1959 by the Award's regulations.**

4. **Your Branch, via its accredited Delegates, has been invited to nominate any qualified member of the Society whom it chooses for consideration for AES Honorary Membership. Your choice must be supported by six copies of a statement of qualifications. These are due in the hands of the Executive Secretary by not later than November 15, 1959 by the rules of the Supreme Society.**

5. **Your Branch, through its President, will be invited to nominate any member of the Society whom it chooses for consideration for the Charles Henry Proctor Memorial Leadership Award. More information soon.**

Dr J. V. Petrocelli

James D. Thomas

Dr. E. R. Bowerman

SEVEN AES RESEARCH PROJECTS ACTIVE

Under the direction of the AES Research Committee headed by Chairman James D. Thomas (General Motors Corporation), seven active AES Research Projects are currently in progress on specific subjects related to electroplating, metal finishing and allied arts. So as to coordinate the important supervisory and other work of various echelons of the AES Research Program structure, including Project Committees and their leadership, the up-to-date Research Manual (1959–1960 Edition) has been prepared by Dr. D. G. Foulke (Vice Chairman for Research) and issued by the Research Committee to some 70 persons involved in the program at directional or supervisory levels.

To fill the vacancy created by the recent resignation of Dr. Frederick A. Lowenheim (Metal & Thermit Corp.), E. R. Bowerman (Sylvania Products Co.) has been appointed District Supervisor covering Project No 16 (University of Pennsylvania) and Project No. 17 (Virginia Institute for Scientific Research). Dr. Joseph V. Petrocelli has, in turn, succeeded Dr. Bowerman as Project No. 16 Chairman. There are three other District Supervisors namely Cleveland F. Nixon, Clyde Kelly and Clarence H. Sample.

AES CONVENTION DIRECTORY

AS OF OCTOBER 1, 1959

1960—
47TH ANNUAL CONVENTION
July 24-28, 1960
Los Angeles, California
Statler Hotel
Host Branch: Los Angeles

General Chairman:
Mr. Tony Stabile, President
Associated Plating Co., Inc.
417 East 16th Street
Los Angeles 15, California

Co-Chairman:
Mr. George J. Hetz
C & W Metal Finishing, Inc.
3525 S. Greenwood Avenue
Los Angeles 22, California

1961—
48TH ANNUAL CONVENTION
June 18-23, 1961
Boston, Massachusetts
Statler Hotel
Host Branch: Boston

General Chairman:
Mr. Louis V. Gagnon
P. O. Box 329
Framingham, Massachusetts

1962—
49TH ANNUAL CONVENTION
June 25-28, 1962
Schroeder Hotel
Milwaukee, Wisconsin
Sponsor: Midwest Regional Council
Host Branch: Milwaukee

General Chairman:
Mr. Herman Tessmann
3864 South 57th Street
Milwaukee, Wisconsin

Assistant Chairmen:
Mr. Eugene Roth
Roth Plating Corporation
739 North College Street
South Bend, Indiana

Mr. Leonard Weeg
National Lock Company
Rockford, Illinois

1963—
50TH ANNUAL CONVENTION
June 24-27, 1963
Ambassador Hotel
Atlantic City, N. J.
Host Branch: Newark

General Chairman:
Dr. D. Gardner Foulke
455 Johnston Drive
Watchung R.F.D. #3
Plainfield, N. J.

1964—
51ST ANNUAL CONVENTION
June, 1964
(Hotel to be announced)
St. Louis, Missouri
Host Branch: St. Louis

Acting Chairman:
Mr. Anthony P. Julius
5520 Itaska Street
St. Louis 9, Missouri

1965—
52ND ANNUAL CONVENTION
June, 1965
Statler Hotel
New York, N. Y.
Host Branch: New York

General Chairman:
Mr. Milton Nadel
9-05 162nd Street
Whitestone 57, New York

CONTENTS

The Role of the Basis Metal in the Production of Stressed Electrodeposits by *Dr. Joseph B. Kushner*, Kushner Electroplating School

Effect of Shot-Peening Prior to Chromium Plating on the Fatigue Strength of High Strength Steel by *Bennie Cohen*, Wright-Patterson Air Force Base

Loose Abrasive Finishing Machines by *Fred T. Hall*, General Motors Corporation

AES Project No. 14—The Influence of Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating
V: Effect of Polishing on the Durability of Nickel Plated Mild Steel by *Dr. Maurice H. Jones and J. Zajdowski*, Ontario Research Foundation

Metal Wastes—Contribution and Effect—Cincinnati Metropolitan Sewage Disposal Service Area by *Fenton H. Dobb*, City of Cincinnati (Sewage Disposal Section)

Ion Exchange and the Pickling of Magnesium Sheet by *Robert E. Anderson*, The Dow Chemical Company

The Use of Bio-assays in the Safe Disposal of Electroplating Wastes by *Dr. Charles M. Tarzwell*, Robert A. Taft Sanitary Engineering Center

Industrial Waste Treatment and Water Reclamation—A Case Study by *Wayne L. Gaspar*, The Maytag Company

Principles of Electrochemistry by *Fred G. Brune*, Chrysler Corporation

Factors Which Influence the Structure of Electrodeposits by *Dr. Abraham M. Max*, Radio Corporation of America

Cleaning, Pickling and Preparatory Surface Treatment by *William P. Innes*, MacDermid, Inc.

Typical Plating Solution—Cyanide Zinc by *Edward F. Foley*, Stratford Chemical Co., Inc.

Alloy Plating Systems for Aircraft Engines by *Bruce E. Scott*, Curtiss-Wright Corporation

Heavy Electrodeposited Metallic and Flame-Sprayed Ceramic Coatings in a High Heat Transfer Aerothermal Environment by *Dr. Stanley Zirinsky*, General Electric Company and *Dr. Dodd S. Carr*, Bart Laboratories & Design, Inc.

Hard Anodizing of Aircraft Fuel Metering Components by *Dr. Harold J. Wiesner and Henry A. Meers*, Bendix Aviation Corporation

Pitting in Thick Chromium Deposits by *Donald R. Millage and Wilbur E. Hague*, The Udylite Corporation

Instrumentation by *Harold A. Kahler*, General Motors Corporation

Design and Engineering Problems in Plating Room Layout and Installation by *Hugh V. McGuire*, Enthone, Inc.

Plating Rack Design and Insulation by *Frank J. Klein*, Rack Processing Company

When and How to Select an Organic Coating by *Harris G. Beck*, The Glidden Company

Vinyl Plastisols and Organosols as Product Finishes by *Fremont L. Scott and William C. Hosford*, Metal & Thermit Corporation

Measurement of Chromium Plate Thickness on Molybdenum Alloy Turbine Buckets by X-Ray Fluorescence by *Dr. William M. Spurgeon and Ottis L. Isaacs*, General Electric Co.

Pattern Plating with Electrodeposits by *Samuel S. Frey*, Oakite Products, Inc.

AES' 1958 TREASURE BOOK OF TECHNICAL KNOWLEDGE STILL AVAILABLE FOR ORDER

Embodying each of the 43 technical papers by experts of nine countries presented before the Fifth International Conference on Electrodeposition and Metal Finishing at the AES's GOLDEN JUBILEE Convention, Detroit, Michigan, June 15-19, 1959, the Golden Jubilee Issue of the AES's book, TECHNICAL PROCEEDINGS (1959 Edition) is nearing completion. Meantime, the Society's limited remaining supply of the 1958 Edition is fast diminishing. Order your copy now.

CONTAINING a full record of the 45th Annual Convention of the American Electroplaters' Society (AES) held in Cincinnati, Ohio, May 19-22, 1958, the AES's 1958 Edition of TECHNICAL PROCEEDINGS publishes, in full, each of the technical papers delivered by experts at the Educational Sessions of that 1958 Convention, including their charts, diagrams, graphs, tables and other illustrations, plus the verbatim discussion that followed their delivery.

It also included the stenotype report of the panel session on "Practical Plating Problems" that was a hit of that Convention.

A larger book than the 1957 edition, it also carries a front section that includes a complete chronological list of AES Conventions and Past Presidents; a day-to-day log of the 45th Annual Convention; a section on the AES Scientific Achievement Award and on the Paper Awards presented at that convention; a full listing of AES's 1958-1959 Boards and Standing and Special Committees and a complete Branch Directory up to date as at September 1, 1958.

THIS book is the only printed medium in which all of the 1958 Convention's technical papers, and the wealth of technical and scientific data that they impart, will be published. Its scope and coverage are demonstrated by its array of papers listed above.

The domestic price of the 1958 Edition of TECHNICAL PROCEEDINGS is $12 per copy including postage. To those ordering from outside of the United States' continental limits, the charge is $15 per copy including postage. All orders must be accompanied by payment in full. Address orders and make checks payable to:

AMERICAN ELECTROPLATERS' SOCIETY

443-445 BROAD STREET • NEWARK 2, N. J.

A limited quantity also exists of the 1957 book at $10 per copy domestic and $12.50 per copy foreign. All orders must be accompanied by payment in full.

FIRST ANNUAL CONFERENCE MIDWEST REGIONAL COUNCIL

AMERICAN ELECTROPLATERS' SOCIETY

SATURDAY, NOVEMBER 7, 1959
ROCKFORD COLLEGE CAMPUS
ROCKFORD, ILLINOIS

9:30-10:00 a.m. Registration and Inspection of Exhibits

10:15-12:15 a.m. Organic Finishing

WORKSHOP SESSION

Moderator—Leslie L. Diveley—Cutler Hammer Company
Panel— Lloyd Gilbert—Rockford Arsenal
Rudolph Hazucha—Clinton Company
Carl Jensen—Glidden Company
Orville Spawn—E. I. DuPont deNemours Company

10:15-12:15 a.m. Inorganic Finishing

WORKSHOP SESSION

Moderator—Ralph D. Wysong—Studebaker-Packard Corporation
Panel— Joseph Andrus—Croname, Inc.
Bernard C. Case—Sunbeam Corp.
Vincent Mattacotti—Milwaukee Plating Company
Craig McAlister—Bussman Mfg. Co.
Phil Ritzenthaler—Plating Engineering Co.
Dr. Harold J. Weisner—Bendix Aviation Company

12:30-2:00 p.m. LUNCH

Luncheon Speaker—Dr. William Blum—Washington, D. C.
Subject—"Education and the Electroplating Industry"

2:15-4:30 p.m. AFTERNOON SESSION

Chairman— Clyde Kelly—American Plating Company

Carl Durbin—Chrysler Corporation—"Experiences in Using the Corrodkote Test"

James D. Thomas—General Motors Corp.—"The Copper Chloride Modification of the Acetic Salt Spray Test"

The Branches of the Midwest Council have been invited to send exhibits to this meeting. It is hoped that the workshop sessions will center around discussions of these exhibits thus giving practical value to those attending. This part of the program is being handled by Harold Ellis of the Rockford Branch

LOS ANGELES EDUCATIONAL SESSIONS TENTATIVELY PROGRAMMED

At its meeting held at National Headquarters, Newark, September 18, the Editorial Board tentatively approved an Educational Sessions Program for the AES's 47th Annual Convention to be held in Los Angeles, July 24–28, 1960 embodying nine sessions and 37 papers.

Among these will be the second annual "William Blum Lecture" to be delivered July 25, 1960 by Dr. A. Kenneth Graham, second winner of the "AES Scientific Achievement Award", the Society's highest scientific honor.

It will include a two-session, ten paper "Hydrogen Embrittlement in Metal Finishing" Symposium being programmed for the Editorial Board and the Host Branch Educational Committee by Dr. Harold J. Read, Professor of Physical Metallurgy, Pennsylvania State University.

Fuller details will be carried in November PLATING.

PHOENIX AND DENVER BRANCHES TO HAVE IMPRESSIVE OCTOBER INSTALLATIONS

Succeeding the resigned Twin City Branch and the inactive San Antonio Branch, a growing number of whose members have now been transferred to other chartered AES Branches or to AES Membership-at-Large, the new Phoenix and Denver Branches have now been permanently chartered by the AES Executive Board, the former effective August 10, 1959, the latter effective August 31, 1959.

The Phoenix Branch, swelling in membership, will be formally presented with its framed permanent charter and officially installed as a full-fledged AES Branch, at an installation ceremony to be held in that City on Friday, October 9, 1959. The installation team of National Officers will be composed of National President Ralph D. Wysong and National Executive Secretary John P. Nichols. The event is being planned under the supervision of Branch President William Griff.

Also growing impressively, the new Denver Branch will have its installation ceremony in Denver, October 13, 1959. The same team of National Officers will serve the Supreme Society. The event is being programmed in collaboration with Branch President Robert D. Martin.

After formal installation into the AES family of chartered Branches, both the Phoenx and the Denver Branches will be eligible to receive the "Thomas A. Trombour Memorial Award" of the Metal Finishing Suppliers' Association (MFSA). Under the provisions of that Award, each newly chartered AES Branch is eligible to be voted a $100 purse by the MFSA's Board of Trustees.

COURSES IN ELECTROPLATING

City	School	Instructor	Semester Tuition Fee	Course Length
Vancouver, B. C.	Vancouver Technical School	Walter Kellermann	Approx. $15	6 mos.
Brooklyn, N. Y.	Fort Greene Evening High School.	Louis Serota	None	18 wks.
Chicago, Ill.	Illinois Institute of Technology	J. M. Andrus	$80	18 wks.
Cleveland	John Jay High School	S. L. Jackson J. A. Zehnder	$ 6	8 wks.
Indianapolis*	Purdue University Extension	Dr. A. M. Max	$45	16 wks.
Montreal	Polytechnique Institute	Dr. Andre Honé	$50	3 yrs.
New Haven	New Haven College	E. F. Foley Jr.	$50	15 wks.
Newark	Various Plants and Laboratories	F. J. LaManna	$20	10 wks.
Philadelphia, Pa.	Temple University Tech. Institute	Dr. S. Heiman	$37 Lab Fee $5	16 wks.
Portland, Oregon	Portland State College	Dr. J. R. Mickelsen	$15	10 wks.
Providence: Attleboro	Central Senior High School	Omer Jette J. Fogarty J. Castriotta	None	2 yrs.
South Bend, Ind.	—	Dr. H. J. Wiesner	—	—
St. Louis	Hadley Technical High School	Dr. Otto C. Klein	$ 9	16 wks.
San Antonio	Trinity University	W. P. Wisdom	$10	18 wks.
San Francisco	—	M. Raskin	$36	18 wks.
Toronto, Canada	Central Technical High School	A. R. Moores	$15-non-res. $ 5-city res.	22 wks.
Evansville, Ind.	Jos. B. Kushner Electroplating School, 621 S. Norman Ave. (Corresp. Course)	Jos. B. Kushner	$150	4 mos. to 1 yr.

The above listings were correct so far as could be ascertained at press time. Prospective students are urged to verify courses prior to making definite plans.

* Every other year. Next semester fall of 1960.

INTERSOCIETY NEWS

EXPECT 50,000 AT ASM METAL SHOW

Returning to Chicago for the 11th time since its inaugural there in 1919, the 41st edition of the American Society for Metals' National Metal Exposition and Congress will be staged Nov. 2-6, 1959.

Theme for both exposition and congress phases of the spectacular annual Metal Show is "Materials and Fabrication Preview of the Soaring '60's". The exposition will be held in the International Amphitheatre of the city with congress sessions in the several Chicago hotels.

Nearly 400 exhibits will occupy 300,000 square feet of exhibit space in the International Amphitheatre and adjoining Exhibition Hall, all at street-floor level and under one roof.

There will be hundreds of engineering and scientific presentations—papers, seminars, panel conferences, lectures. ASM and congress headquarters are to be in Hotel Sherman. Four of the seven cooperating societies will utilize the meeting rooms of four other hotels. Attendance in the high thousands is expected.

Metalworking's continuous search for cost-saving techniques is expected to lend more than a touch of urgency to Metal Show-1959 activities of industry buying teams.

Among recent developments to be eyed by Metal Show visitors at the show and explored by scientists and engineers at the technical sessions are advances in high strength steels, composite materials, super thin stainless steel, alloy strip, vacuum melting, and many others.

Many Metal Show exhibits will be displayed in special industry sections. An instrumentation area is planned for sensitive precision equipment—with minimized noise, vibration and dust.

Another section will be devoted to producers and fabricators in the powder metallurgy field, including both members of the Metal Powder Industries Federation and the Federation itself as exhibitors.

Those cooperating with the ASM in technical and allied presentations of the 41st Congress (with their hotel headquarters) will be the American Institute of Mining, Metallurgical and Petroleum Engineers (Institute of Metals Division, Iron and Steel Division and Extractive Metallurgy Division) (Morrison Hotel); Society for Nondestructive Testing (Hamilton Hotel); American Society for Testing Materials (Bismarck Hotel); Special Libraries Association (LaSalle Hotel); Ultrasonic Manufacturers Association (Hotel Sherman); Metal Powder Industries Federation (Sherman); and the Metal Treating Institute (Sherman).

Outstanding among the many special luncheons, dinners and Society gatherings of the ASM and cooperating societies will be the 4th Annual ASM Awards Luncheon on Tuesday (Nov. 3) of Metal Show Week. Speaker will be Thomas F. Patton, president of Republic Steel Corp.

New ASM Officers

New Metal Society officers will be elected at the annual meeting of the society, Wednesday morning, Nov. 4. They are: President, Walter Crafts, associate director, technology, Union Carbide Metals Co.; Vice President, William A. Pennington, professor of metallurgy, University of Maryland; Treasurer, R. J. Raudebaugh, supervisor, iron-nickel alloys, International Nickel Co.; and Trustees, Albert H. Fairchild, senior staff engineer, metallurgist, Western Electric Co.; and Carl H. Samans, associate director, engineering research, Standard Oil Company (Indiana). President Lorig, following completion of his current term, remains on the board of trustees as past president. Continuing also on the board will be Earl R. Parker, professor of metallurgy, University of California, and Merrill A. Scheil, director of metallurgical research, A. O. Smith Corp. Walter E. Jominy, consultant, the Chrysler Corporation, continues as society secretary.

INSTRUMENT SOCIETY SYMPOSIUM

A series of 16 papers evaluating "Solid Facts About Solid State" from the viewpoint of the instrument engineer will be presented at a two-day symposium in Philadelphia on Nov. 23 and 24, 1959. To be held in conjunction with an equipment display at the Benjamin Franklin Hotel, the symposium is sponsored by the Philadelphia Section of the Instrument Society of America, with AIEE and IRE as cooperating societies.

Subjects and speakers have been selected for their ability to draw a broad, well-rounded picture of this latest trend in instrumentation. The Philadelphia Section of the ISA has extended a blanket invitation to all business groups interested in this field.

NEW PRODUCTS AT CHEMICAL EXPOSITION

News of the 27th Exposition of Chemical Industries reveals an increasing number of exhibits and a greater variety of chemical processing equipment in prospect than at any previous display of its kind. Scheduled for N. Y. Coliseum, Nov. 30 to Dec. 4, the exposition will present many exhibits with direct applications in the rapidly expanding fields of missiles, nucleonics, electrochemicals, petro-chemicals and ceramics.

A noteworthy factor in this year's display will be the heavy emphasis that exhibitors will place on more highly resistant chemical processing equipment. This will be evident at all stages from the raw and fabricated materials through specialties to the complete units which will be on display throughout the exposition.

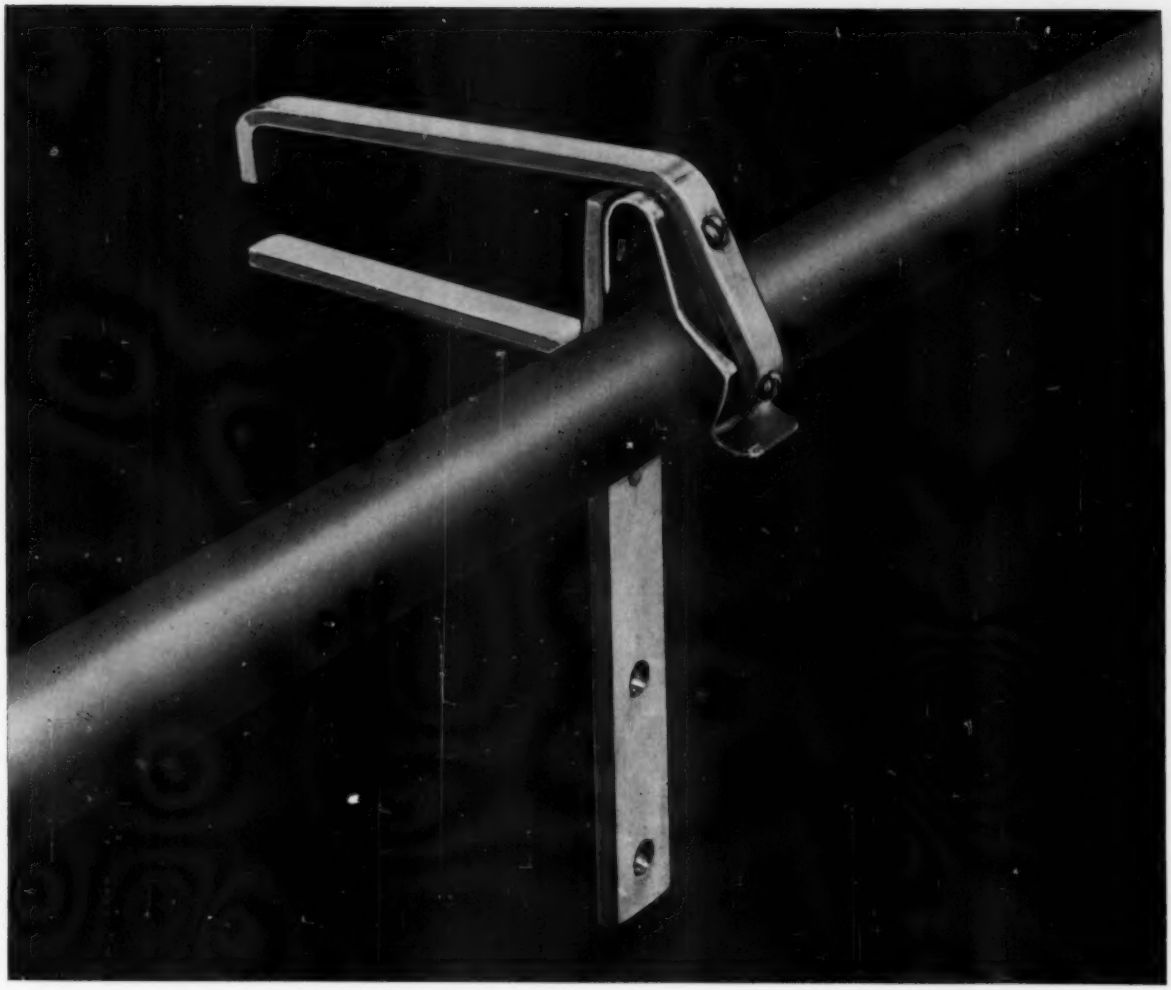
A new super stainless steel for resisting hot sulfuric acid, one of four types of stainless pipe and tubing to be offered by a well-known steel maker will be available in pipe, tubing, strip, sheet, plate and bar.

Aluminum bronzes in various forms are already in wide use for corrosive resistant applications, but one important source of such alloys has added a new grade that promises freedom from stress corrosion cracking. Field welding or fabrication may be performed without need for subsequent stress relieving.

An advisory committee composed of 18 men prominent in chemistry and chemical engineering has been appointed for the Exposition. Heading the group as its chairman is E. R. Weidlein, trustee of Mellon Institute, who is associated with many important scientific and research projects.

Other members of the Committee are: Roger Adams, head, chemistry department, University of Illinois; William S. Auchincloss, publisher, "Oil, Paint & Drug Reporter"; John C. Bailar Jr., President, American Chemical Society; J. V. N. Dorr, chairman of the board, Dorr-Oliver, Inc.; Howard Farkas, President, The Chemists' Club; W. C. Gardiner, president, The Electrochemical Society; R. P. Genereaux, engineering dept, E. I. du Pont de Nemours & Co.; Donald L. Katz, president, American Institute of Chemical Engineers; Raphael Katzen, chemical engineer.

Sidney D. Kirkpatrick, editorial director, "Chemical Engineering" and "Chemical Week"; Walter E. Lobo, Devys & Lobo; Robert B. MacMullin, senior partner, R. B. MacMullin Associates; Walter J. Murphy, editorial director, ACS Publications; W. T. Read, consultant; N. A. Shepard, consultant; Julian C. Smith, professor chemical engineering, Cornell University; J. E. Spencer, president, Salesmen's Association of American Chemical Industry, Inc.



Spring Clamp Cathode Hook improves plating – avoids rejects

Powerful spring tension assures uninterrupted flow of plating current to the cathode rod from articles being plated — avoids the partial plating and costly rejects that so often occur when you depend on gravity for contact pressure.

The Spring Clamps also hold racks rigidly where you put them on the cathode rod — they cannot creep together even with "sway-back" rods and rod agitation.

The Spring Clamp Hooks bolt to any rack. No need to get a Spring Clamp Hook for every rack — just change the hooks from idle racks to the racks in use.

Order Spring Clamp Cathode Hooks today! Enjoy the unstinted flow of plating current through articles being plated. Notice the superior plating and elimination of rejects.

Locks rigidly
Just squeeze to put on or take off

Made for rack spines of all sizes and makes

Made for 1", 1¼", 1½" and 2" Cathode Rods

When ordering please specify

1. Diameter of cathode rod
2. Maximum amperage required by rack

Rack MANUFACTURING COMPANY
947 N. Cicero Ave., Chicago 51, Ill.
EVERYTHING FOR PLATING PLANTS

INDUSTRY NEWS

Dr. Francis Horn (center) president of the University of Rhode Island accepts the Operation Manual for the Jet Plater from Oscar Stocker, Sel-Rex representative, T. Stephen Crawford (right) is director of the University's Division of Engineering Research and Development.

SEL-REX DONATES PLATER TO UNIVERSITY OF R. I.

A Jet Plater, described as a complete precious metals electroplating facility, has been donated by Sel-Rex Corp., Nutley, N. J., to the University of Rhode Island, to be used in research as an aid the jewelry manufacturing industry.

According to T. Stephen Crawford, director of the University's Division of Engineering Research and Development, he and his associates have for many years been anxious to expand the scope of their research program for the jewelry and other related industries. "Such an activity would be devoted to seeking better materials, processes and methods to help American manufacturers produce quality products at prices competitive with those of foreign imports." said the director.

Morris M. Messing, president of Sel-Rex, expressed the hope that his company's donation of the Jet Plater would serve well the university's program. "Active support of the research program sponsored by the University of Rhode Island, on the part of appropriate organizations and individual companies, is simply a matter of enlightened self interest." he said. "That it would be good for the industry is self evident, and what is good for the industry as a whole has got to be good for the individuals who are parts of it."

SALES TERRITORIES SET BY ALLIED RESEARCH

Allied Research Products, Inc., Baltimore has completed the realignment of its national sales districts. The new district arrangement is the result of Allied's acquisition a year ago of the products and facilities of Wagner Brothers, Inc.

The Northeastern District is under the direction of Frank Richard as district sales manager with headquarters at Bridgeport, Conn., and includes six representatives and distributors in Connecticut, New York, Massachusetts, Rhode Island, Maine, New Hampshire, Vermont, New Jersey and Eastern Penn.

The Central District is under the direction of L. J. Camill as district sales manager in Detroit, Mich. It includes Michigan, Ohio, Indiana, Kentucky, Western Pennsylvania and West Virginia. Ten representatives cover this area.

The Midwest District is under the direction of A. L. Poe as district sales manager with headquarters in Chicago, Ill. Eight representatives and distributors cover Illinois, Iowa, Nebraska, Arkansas, Louisiana, Missouri, Mississippi, Oklahoma, Tennessee, Kansas, Colorado, Texas, Minnesota and Wisconsin.

Sales direction for the balance of the country through a network of distributors, is provided by J. A. Cairns, vice president of sales, from headquarters in Baltimore.

COLORADO DISTRIBUTOR NAMED BY H-VW-M

Hanson-Van Winkle-Munning Co. has appointed the Chemical Sales Company of Denver, Colorado, its exclusive distributor in the state of Colorado.

Chemical Sales Co., headed by M. M. Katz and assisted by Dr. Paul G. Gordon, will handle H-VW-M's complete line of equipment and supplies. Chemical Sales maintains a laboratory facility. The company was organized in 1927. Headquarters are at 1125 Seventh Street, Denver.

NARDA ULTRASONICS EXPANDS

The Narda Ultrasonic Corp. has just expanded into a second building in the New Cassel area of Westbury, N.Y. The new building is a 10,000 square foot, one-story structure at 50 Sylvester Street adjacent the main Narda plant.

Dr. John C. McGregor, president of Narda, said the new building was made necessary by the company's greater emphasis on research and development. "We hope to create many new products to meet the growing demands of industry and the military services for advanced types of ultrasonic cleaning systems and process devices."

Although less than two years old, Narda reportedly has produced more ultrasonic cleaning units than the entire industry had turned out in the previous decade. Narda was the first ultrasonic equipment manufacturer to standardize equipment and manufacturing techniques in contrast to the old, costly practice of producing ultrasonic equipment only to order.

Major Stanley P. Sax, judo instructor to Reservists of 9857th Engineering Unit at Camp McCoy, Wis., "flips" his commanding officer, Col. Rudolph F. Cernick. Major Sax in civilian life is executive vice president of the American Buff Co., Chicago. The training is given to men who might be forced to defend themselves in combat without a weapon.

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In the finishing of brass (and bronze) a wide variety of effects can be obtained with LEA COMPOUND, ranging from non-reflective brush brass or satin finishes to almost a high lustre finish. Results depend on the grade of LEA COMPOUND, the type of wheel and the surface speed of the wheel. In general, the coarser grades of LEA COMPOUND, such as Grades "C", "B" and "L", produce the duller type of finish. Soft-faced wheels and low-surface speeds produce duller finishes than when the same grade of LEA COMPOUND is used on a more rigid type wheel or at a higher surface speed.

LEA COMPOUND is used to good advantage for replacing set-up wheels in the finer numbers where set-up wheel operations (180 to 240) are necessary on castings, forgings, die cast brass, etc. When LEA COMPOUND is used on a resilient wheel, brass shows practically no tendency to drag.

For high-lustre buffing on brass and its alloys where contours and ornamentations tend to pack up with the ordinary buffing compositions, a suitable grade of LEAROK, the buffing bar with no free-grease or LEA LIQUABRADE, liquid buffing composition, should be used.

POLISHING...Recommended polishing speeds for brass with conventional wheels are around 7000 sfm. Grade "B" LEA COMPOUND is frequently used at 6000 sfm for polishing brass with sewed buffs, canvas, felt or solid leather polishing wheels. With rigid wheels and heavy LEA COMPOUND heads, the use of Grade 155 LEAROK or LEA LUBAR is recommended as a lubricant.

INTERMEDIATE FLEXIBLE POLISHING... Where small defects, flash, etc., are to be removed, use LEA COMPOUND (such as Grade "B-31" or "C") on sewed buffs or loose muslin sections at 5500 sfm.

SATIN FINISHING...This is a final finish, produced at surface speeds of 3500 to 5500 sfm with LEA COMPOUND such as Grade "C", "B" or "N" on loose muslin buffs, ventilated or bias buffs, string or wick wheels with or without LEAROK 155 or LUBAR as a lubricant, according to the line-effect desired.

BRIGHT FINISHING (Bar Compositions)...To produce this finish, showing no surface defects, use Grade "B-31" LEA COMPOUND on a loose muslin buff at 3000 to 5000 sfm, followed by Grade 765 or 884 LEAROK on a loose muslin buff at 7000 to 8000 sfm.

BRIGHT FINISHING (Liquid Compositions)...All operations at 7000 to 8000 sfm. LEA LIQUABRADE (liquid abrasive composition) in a suitable grade applied automatically with spray guns gives excellent bright finishes:

Cut—TH52P and TH62M LIQUABRADE
Color—UH20A or 63LR LIQUABRADE
Buff—Ventilated or Loose Muslin

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Lea Mfg. Company of England, Ltd., Buxton, Derbyshire, England
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INDUSTRY NEWS BRIEFS

BUREAU OF MINES COPPER RESEARCH TO INCLUDE EFFECT OF ULTRASONIC WAVES ON ELECTRODEPOSITION

Bureau of Mines research on copper during fiscal year 1960, which began July 1, will stress improved methods for increasing metal recovery and cutting production costs, the Bureau has announced.

In the open-pit studies, methods for improving pit design will be included. During the year, information will be obtained by Bureau engineers on mining methods and costs at various copper mines, and the findings will be issued as public reports.

Metallurgical research in copper will cover many fields. The studies on extracting copper from oxide and mixed oxide-sulfide ores by the segregation process will be intensified and will be completed during the year.

Other copper metallurgical research by the Bureau will include studies on the dissolution of copper sulfide minerals at elevated temperatures and pressures; deoxidation of blister copper by such gases as carbon monoxide, hydrogen, methane, or their mixtures; the effect of ultrasonic waves of various frequencies and intensities on the electrodeposition of copper, etc.

HAMILTON WATCH SEEKS CONTROLLING INTEREST IN WALLACE SILVERSMITHS

The Hamilton Watch Company of Lancaster, Pa. is prepared to invest about $7 million in its plan to purchase the assets of Wallace Silversmiths, Inc., of Wallingford, Conn., it has been disclosed. Hamilton has set Oct. 30 as the deadline for its plan to obtain two-thirds of the capital stock of the 94-year old firm.

In connection with the announcement that Hamilton was interested in obtaining a controlling interest in the local firm, president H. S. Stone Jr., of Wallace has issued a statement in which he assures the city, the firm's 900 employes and others interested that regardless of the success of Hamilton's negotiations the company will remain in Wallingford and plans will be carried out to expand facilities.

LEAD AND ZINC QUOTAS OPPOSED

Six major U. S. lead and zinc smelting companies have joined together in strong opposition to the present United States Government quotas on imports of lead and zinc and have recommended that quotas be rescinded and replaced by increases in the appropriate customs duties.

The companies, which have presented a joint statement before the United States Department of Commerce, represent approximately 50 per cent of the domestic lead and zinc smelting and refining capacity. They are American Smelting and Refining Company; American Zinc, Lead and Smelting Company; Athletic Mining and Smelting Company; Blackwell Zinc Company, Inc.; Matthiessen and Hegeler Zinc Company and National Zinc Company, Inc.

COPPER SULFATE PRODUCTION OFF

Production of copper sulfate in the United States in July 1959 dropped for the third successive month and was 8 per cent less than in June, according to the Bureau of Mines, United States Department of the Interior. Shipments fell 21 per cent but were 750 tons in excess of production; and stocks declined 20 per cent. Inventories were sufficient for almost one month's requirements at the July rate of shipments.

There were no imports of copper sulfate in July. Exports of copper sulfate totaled 36 tons.

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PATENT ABSTRACTS

DR. D. GARDNER FOULKE
SEL-REX CORPORATION
Nutley, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,871,175, 1/27/59—Electropolishing—D. Zaremski, assignor to Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Claim 1 reads: "The method of electropolishing the surface of an object made of a metal selected from the group consisting of titanium, titanium base alloys, zirconium and zirconium base alloys which comprises, immersing said object in a molten bath that consists essentially of an alkali metal hydroxide, providing at least one other metallic object in said bath that is more noble in said bath to titanium, zirconium and alloys thereof and providing an electric coupling between said objects so as to provide an electric current."

9 claims, 2 figures.

No. 2,871,177, 1/27/59—Electrolytic Grinding—G. Comstock, assignor to Norton Company, Worcester, Mass.

Equipment for the electrolytic grinding of metals is described.

3 claims, 5 figures.

No. 2,872,387, 2/3/59—Anodic Treatment of Uranium—M. Kolodney, assignor to the U.S.A. (AEC).

Make the uranium anodic in a phosphoric acid solution containing the nitrates of ammonium, sodium and potassium.

16 claims.

No. 2,879,186, 3/24/59—Blanching Zirconium—W. Fischer, assignor to Aktiengesellschaft für Unternehmurzen der Eisen- und Stahlindustrie, Essen, Germany.

Zirconium surfaces may be cleaned of scale in a molten fluoride salt bath.

12 claims.

No. 2,879,195, 3/24/59—Flux—D. Speed and I. Smith, assignors to E. I. du Pont de Nemours and Co., Wilmington, Del.

A galvanizing flux is described as containing ammonium chloride zinc chloride, zinc ammonium chloride and 0.04 to 0.4 gram of an alkyl sulfonate per 100 g of flux.

8 claims.

No. 2,879,209, 3/24/59—Electroforming System—S. Failkoff, Camin Laboratories, Brooklyn, N. Y.

Electroform a metallic shell over a mandrel, remove, fill with water and continue the plating operation.

1 claim.

No. 2,879,210, 3/24/59—Electroplating on Aluminum—A. Howard, assignor to Steel Protection and Chemical Co., Inc.

Claim 1 reads: "In a continuous process of preparing elongated

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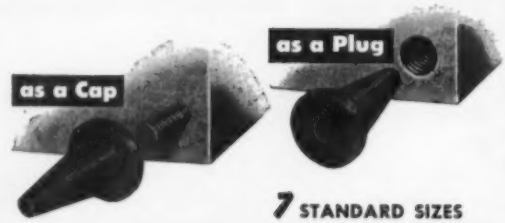

7 STANDARD SIZES

	A	B	C	D	E	F	G
TO PLUG HOLE SIZE	1/16-3/16	3/16-1/4	1/4-5/16	5/16-1/2	1/2-5/8	9/16-11/16	5/8-3/4
TO CAP STUD SIZE	3/32-5/32	5/32-3/16	3/16-1/4	1/4-5/16	5/16-3/8	3/8-7/16	5/16-1/2

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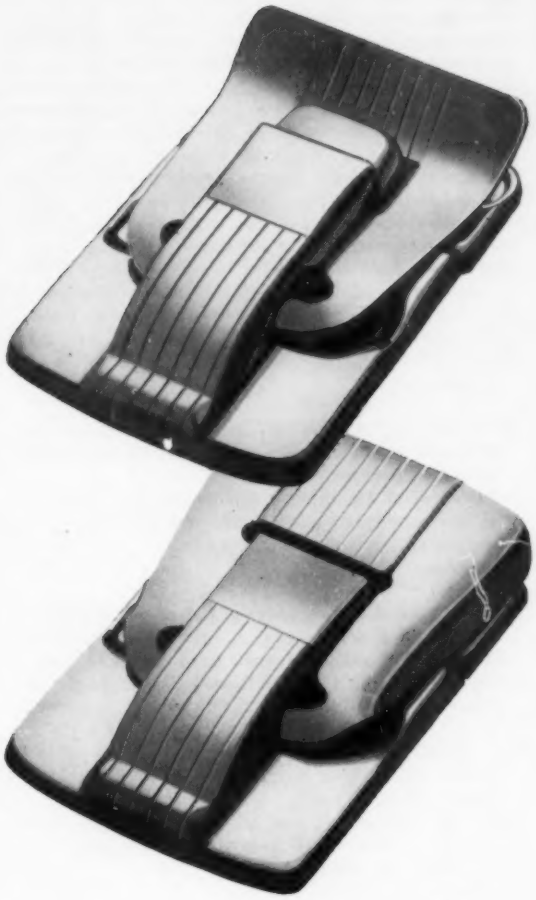

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The SEYMOUR MANUFACTURING CO.
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aluminum in wire or strip form preliminary to a final plating, the steps comprising cleaning the aluminum to obtain a substantially chemically pure surface thereon; continuously passing the aluminum as a cathode through a first aqueous alkaline solution consisting essentially of lead and zinc ions in the ratio of from 0.4 to 2.0 of lead to 5 to 15 g of zinc/l, a chelating compound, and sodium cyanide in the presence of a carbon anode while passing an electric current between the cathode and the anode, producing a lead-zinc strike directly on the aluminum; and continuing the travel of the aluminum directly from said solution immediately into and continuously through, while connected with said current as a cathode, a second solution containing copper cyanide to receive a copper strike over said lead-zinc strike in the presence of a copper anode while passing an electric current between the cathode and the anode; the dwell period of the aluminum in said first solution ranging from approximately five to ten sec, and providing a lead-zinc strike limited to from two to three millionths of an inch."

4 claims, 1 figure.

No. 2,879,211, 3/24/59—Electroplating Duplex Nickel—O. Kardos and R. Neumann, assignors to Hanson-Van Winkle-Munning Company.

A method of depositing a duplex coating of nickel by first plating without agitation then without transfer providing application of agitation to supply a duplex coating.

10 claims.

No. 2,880,109, 3/31/59—Coating Cylinders—F. Current and G. Mohnkern, assignors to U. S. Steel Corp., New Jersey.

Finely divided nickel alloy particles are held within a rotating cylinder and inductively melted to coat said cylinder.

2 claims.

No. 2,880,115, 3/31/59—Gas Plating Light Metals—F. Drummond, assignor to Commonwealth Engineering Co., Dayton, Ohio.

Heat the article in an inert atmosphere and contact with an alkyl or aryl compound of aluminum or magnesium to deposit said metals on the article.

2 claims.

No. 2,880,125, 3/31/59—Flux—E. Jordan and F. Lederer, River Forest and Chicago, Illinois, respectively.

A flux is described containing an ammonium derivative (urea, NH_4Cl, NH_4Br) and 80 to 99 per cent of an amine hydrohalide.

See also No. 2,880,126 also describing a flux in 13 claims.

8 claims.

No. 2,880,156, 3/31/59—Production of Metals—F. Benner and E. Chadsey, assignors to National Research Corp., Cambridge, Mass.

The electrolytic preparation of pure titanium is described. 4 claims, 3 figures.

No. 2,880,147, 3/31/59—Electrolytic Process—G. Cunningham, assignor to Horizons, Inc., Princeton, N. J.

A method for depositing ferrous metal in a form easily stripped wherein the cathode is coated with ethyl cellulose and graphite before plating.

3 claims.

No. 2,880,148, 3/31/59—Coating Magnesium—H. Evangelides, Chalfont, Pa.

An anodizing bath for magnesium is described as containing 1 to 60 g/l of a compound selected from sodium and potassium chromates, selenates, tungatates, vanadates, molybdates and borates and 1 to 300 g/l of sodium or potassium fluoride, 10 to 300 g/l of sodium or potassium phosphate, 20 to 130 g/l of sodium or potassium hydroxides and 1 to 125 g/l of an aluminum compound (hydroxide or alkali aluminate).

14 claims.

No. 2,880,149, 3/31/59—Electrolytic Process—S. Carlton and B. Raynes, assignors to Horizons Titanium Corp., Princeton, N. J.

A method of refining impure titanium, hafnium and zirconium in a molten salt electrolyte is described.

See also an electrolytic method and apparatus for fused salt use, No. 2,880,150 to Frank Howard of New York. 4 claims.

See also an electrolytic method for the production of magnesium from molten baths by L. Dean, et al, assigned to Dow Chemical Company. No. 2,880,151 with 2 claims.

12 claims.

No. 2,880,554, 4/7/59—Polishing Apparatus—L. Simjian, assignor to Reflectone Corp., Stamford, Conn.

A polishing apparatus consisting of a non-magnetic container, a mixture of abrasive paramagnetic particles in a liquid and a magnetic means to swirl particles around the work piece is described.

2 claims, figure.

No. 2,881,089, 4/7/59—Mirror Coating Alloys—W. C. Herrmann, assignor to Texas Instruments, Inc., Dallas, Texas.

An alloy of 80 per cent aluminum and 10 per cent beryllium is heated in a vacuum to ablate beryllium first on a beryllium object and later aluminum to form a coating with high reflectance.

2 claims.

No. 2,881,094, 4/7/59—Coating with Nickel—T. Hoover, assignor to USA (AEC).

Contact a surface with nickel carbonyl vapor along with 0.1 to 1.0 per cent of H_2S by volume at 60 to 100C.

3 claims.

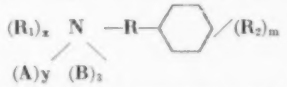
No. 2,881,119, 4/7/59—Titanium Plating—Leo Goldenberg, Prince Georges County, Md.

A molten salt bath consisting essentially of magnesium chloride is described as useful to plate titanium and zirconium when oxygen free anodes of said metals are used.

8 claims.

No. 2,881,120, 4/7/59—Electroplating Nickel—J. Towle and James Long, Cleveland, Ohio.

A bright nickel process is described as containing as addition agent sulfo oxygen compounds and a compound of the formula



as for example N-methyl 4-(4′ phenylbutadienyl -1′, 3′) quinolium perchlorate.

8 claims.

No. 2,881,121, 4/7/59—Copper Plating—D. Foulke, O. Kardos and H. Koretzky, assignors to H-VW-M Co., Matawan, N. J.

A bath for bright copper plating is described as containing a selenium compound and a water soluble acetylenic compound.

See also No. 2,881,122 by same inventors describing a bright copper bath containing a tellurium compound and an acetylenic compound in 16 claims.

11 claims.

No. 2,881,514, 4/14/59—Aluminized Magnesium—F. Drummond, assignor to The Commonwealth Engineering Co., Dayton, Ohio.

Clean the magnesium, lay down a coating of Ni, Cu, Fe or Cr by gas plating then apply aluminum metal onto the bonding metal layer in the form of a metal deposit of aluminum.

See also No. 2,881,518 describing continuous gas plating with 1 claim and figure.

5 claims, figure.

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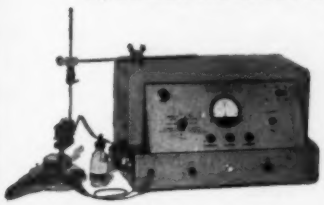

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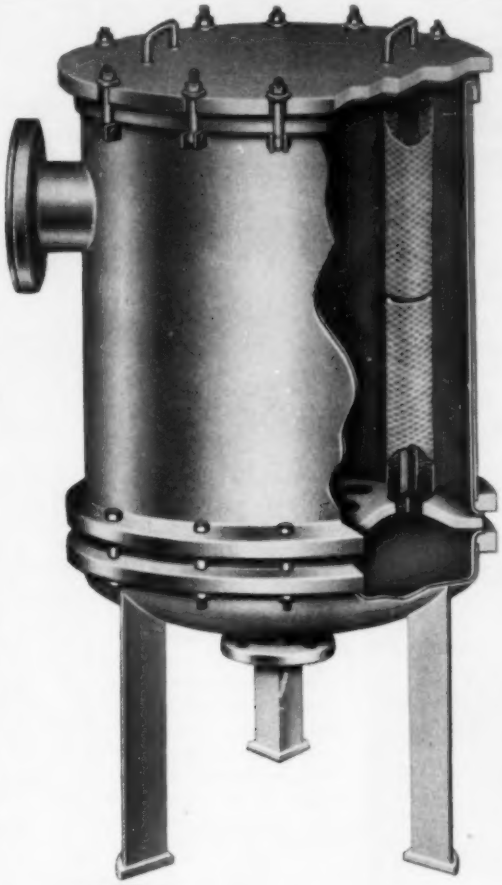
45th Annual Technical Proceedings, American Electroplaters' Society—1958. Convention papers plus discussions...	12.00	12.00
Foreign.....	15.00	15.00
Specifications and Tests for Electrodeposited Coatings, 1958..... Standards of ASTM Committee B-8.	2.25	2.00
Control in Electroplating—Symposium.... Institute of Metal Finishing, England. Papers by K. E. Langford, T. E. Such, C. F. Corfe and D. W. Smith. 92 pages.	2.50	2.00
Effect of Surface on the Behaviour of Metals Papers by G. L. J. Bailey, T. P. Hoar, F. T. Barwell and R. W. B. Stephens. 100 pages.	10.00	8.35
Paint Finishing in Industry..... by A. A. B. Harvey. 516 pages.	12.00	9.60
The Structure of Steel..... by Edwin Gregory and Eric N. Simons. 176 pages.	10.00	8.35
New Instrumental Methods in Electrochemistry..... by P. Delahay. 455 pages.	13.00	12.00
Semiconductor Abstracts—Compiled by Battelle Memorial Institute, Sponsored by The Electrochemical Society..... Volume IV—1956. 456 pages.	12.00	10.00
Aluminum Paint and Powder—3rd edition. by J. D. Edwards and R. I. Wray. 228 pages.	5.50	4.60
Electroanalytical Chemistry..... by J. J. Lingane. 683 pages.	13.05	12.55
Chromium—Two Volumes. Both..... Edited by Marvin J. Udy. 857 pages.	19.50	16.55
Volume 1—447 pages.....	11.00	9.35
Volume 2—410 pages.....	11.00	9.35

Prepayment Should Accompany All Orders



NEW Fulflo PLATING FILTER cuts maintenance costs in half

The new Fulflo Rubber-Lined Steel Filter for plating saves you money in servicing and cleaning.

In addition to reduced maintenance costs you get even more savings in the low initial cost.

So look into the new Fulflo Plating Filter — available in six sizes, with from 6 to 60 Honeycomb Filter Tubes, for capacities up to 18,000 gph.

For new folder, write to Department PL

Easier to Service: New Plating Filter is easier to service because of the new swing-bolt cover. Just loosen the bolts, swing them out of the way, and lift off the cover. In a matter of minutes, you quickly change the patented Honeycomb Filter Tubes.

Easier to Clean: Filter is easier to clean because of the new bottom outlet. By simply adding a "T" connection and drain valve, you quickly clean the entire vessel.

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

TRADE LITERATURE

L—1001. Masking Aids—A new masking brochure has been issued by By-Buk Co.

Masking tape discs in sizes from ⅛ in. in diameter, discs made from special tape for anodized surfaces, heavy cardboard discs for flush masking, taper and self-threading plugs, very narrow masking tape as small as $^{1}/_{32}$ in. wide are among the many masking aids illustrated and for which dimension specifications are provided.

L—1002. Abrasive, Polishing Wheels—Rubber bonded abrasives for polishing and finishing such as rubber bonded polishing wheels, unfinished sticks and stones, special purpose stones, and wheel dressers and sticks are featured in a new Carborundum Co. white and blue folder.

Their special function and types of materials on which they are particularly useful, specifications and prices are set forth.

L—1003. Finishing Data Summary—A pocket-size reference summary of metal finishing literature produced by MacDermid Inc. is now available on request. This summary folder lists data sheets by number, trade name and use. MacDermid technical data sheets give metal finishers where-to-use information, make-up, operating instructions, analysis and control for a wide variety of cleaners, copper-plating processes, dry acid salts, Macromate coatings and many other specialties.

Also available now is the company's technical data sheet No 92 which describes Metex Electropolish BC, an acidic solution for producing a bright finish on copper, copper plate or brass.

L—1004. Demineralizer—Laboratory demineralizer MBD-6A is described in Permutit Company's bulletin 4553.

L—1005. Plating Generator Brush—Copies of a brush maintenance manual for low voltage generators are now available from National Carbon Co. division of Union Carbide Corp. The 16-page illustrated booklet contains practical tips on brush operation and maintenance on high-current, low-voltage generators used in electrolytic processes.

Included in the manual is a discussion of metal-graphite brushes used in plating generators, together with explanations of contact drop, friction, resistivity, and commutator surfacing.

L—1006. Immersion Heaters—Discussed in this third technical bulletin of Sellers Engineering Co. are the large-volume water heating benefits which result from correctly engineered application of immersion tube heating. Entitled "Bonus Advantages of Immersion Firing," the bulletin discusses spreading out the fire, more uniform use of the heating surface, underfiring, the Scotch Marine design, and four pass design." Also included is a recipe entitled Carl's Green Beans.

Photo courtesy Hanson-VanWinkle-Munning Co.

STOP CORROSION and CONTAMINATION

Where you use corrosive acids and other chemicals for pickling and metal plating be sure it's Manhattan Rubber Linings that protect your costly equipment. Thick, multiple calendered sheets of natural or synthetic rubber are bonded to tank metal so securely they can't be separated! Manhattan Rubber Linings eliminate the dangers of stray currents in plating operations. They expand and contract with metal . . . won't harden, crack or oxidize — even under extreme temperature change. To assure lifetime protection, every Manhattan rubber lined tank is tested under high voltage to detect any possible imperfections before being shipped.

Get the kind of *permanent protection* that has kept many Manhattan Rubber Lined tanks in continuous use over thirty years. Specify "Manhattan" on your equipment. Contact the Manhattan rubber lining facilities nearest you.

MULTIPLE CALENDERED SHEETS
•
PERMANENT RUBBER-TO-METAL BOND
•
POSITIVE PROTECTION FROM STRAY CURRENTS

RM-924

RUBBER LINING PLANTS AT PASSAIC, N. J. • NORTH CHARLESTON, S. C.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose Fan Belts • Brake Linings & Blocks • Clutch Facings • Packings • Asbestos Textiles Engineered Plastic, and Sintered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

NEW IMPROVED

VITREOSIL®

ELECTRIC IMMERSION HEATERS

7

WAYS BETTER!

1 Better resistance to corrosion, thermal shock, high temperature.

2 Better compactness, safety, efficiency.

3 Better resistance to chemicals, regardless of temperature or concentration.

4 Better heat transfer per unit area.

5 Better sealing and easier installation with moulded rubber cap.

6 Better electrical protection — ground wire inside Vitreosil sheath.

7 Better application — minimum safe immersion depth marked on each heater.

Vitreosil Electric Heaters are made of pure fused silica . . . offer greater efficiency for use in acid pickling and electroplating solutions, and other acid baths. Write for our bulletin for more information and prices. See our ad in Chemical Engineering Catalog.

THERMAL AMERICAN FUSED QUARTZ CO., INC.
18-20 Salem Street
Dover, New Jersey

Please send technical data on _____

Company Name and Title
Street
City
Zone___State _____

L—1007. Vibrator—Four-page, bulletin No. 1930E describes new 15-hp Lorco vibrator, latest addition to a line that includes 30-hp and 20-hp models of similar design. The Lorco vibrators employ controlled vibration for precision finishing of a wide range of types, shapes and sizes of metal, plastic and wooden parts. Lord Chemical Corp. claims operation is from 10 to 100 times faster than tumbling barrels. Detailed specifications are given for the new model as well as construction features, standard equipment and general information.

L—1008. Reinforced Plastic Standards—The Ceilcote Co. has made available what it believes are the first standards ever published for reinforced plastic fabrications in a new six-page brochure.

The subject is covered in terms of the new visual standards as well as advanced material specifications including physical properties. The visual standards section features many comparative photographs of acceptable and unacceptable workmanship in common design configurations plus an evaluation of possible performance. The materials specifications section describes the important requirements essential to the proper fabrication of serviceable structures.

L—1009. Nozzles—The Industrial Nozzle Division of Wm. Steinen Manufacturing Co. has announced the publication of a new catalog covering their line of industrial spray nozzles.

The catalog contains 32 pages of listings and data on nozzles for industrial spraying applications. Specific data on spray angles, dimensions, types of connections, and capacity vs. pressure for all standard nozzles are presented in simplified selection tables. The catalog is illustrated to give details of flow and spray patterns.

L—1010. Selective Plating—A four page illustrated brochure describing the Dalic process of electroplating selected areas without using immersion tanks has been issued by Sifco Metachemical, Inc.

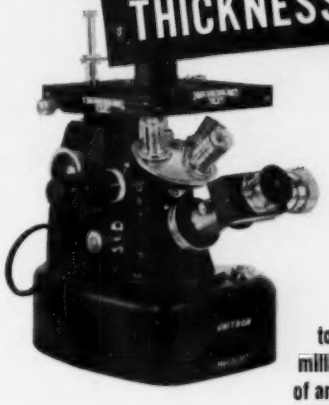
L—1011. Rectifiers — Hanson-Van Winkle-Munning Co. announced the availability of three bulletins describing and illustrating the new H-VW-M general industrial rectifier line and plating and anodizing lines.

Silicon, germanium and selenium rectifiers ranging in voltage from one to 500 and in amperage from 25 to 12,500 are described.

The bulletins should help answer such questions as: What kind of rectifiers are available? What kind of rectifiers should you buy? What kind of controls should you order? What kind of protective systems are offered?

WHY GUESS ?

MEASURE PLATING THICKNESS



to a millionth of an inch

Your profits depend on meeting tight specifications, maintaining quality control and reducing rejects. Can you afford to guess at plating thickness when it is so easy to measure and be sure?

UNITRON'S PL-MEC PLATER'S MICROSCOPE substitutes facts for uncertainty. The plated deposit is observed through a Filar Micrometer Eyepiece and measurements are read directly from a micrometer drum. This compact microscope is easy to use, portable around the shop and has a built-in light source. It also doubles as a metallurgical microscope for examining grain structure etc. at magnifications of 25X-1500X. Permanent photographic records may be made using an accessory 35mm. camera attachment and provide valuable legal protection for subcontractors.

UNITRON'S PLATER'S MICROSCOPE will save its initial cost many times over. Prove this for yourself — as so many firms in the plating industry have done—by requesting a FREE 10 DAY TRIAL in your own plant. There is no cost and no obligation.

Above: Accessory camera attachment.
Left: Observing the plated deposit.

$468 Model PL-MEC complete with all optics and standard accessories

As above with built-in camera attachment, but without 35mm. camera back: $540

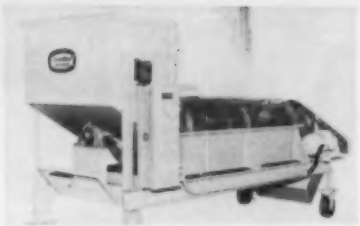
THE TREND IS TO UNITRON

UNITRON
INSTRUMENT DIVISION OF UNITED SCIENTIFIC CO.
204-206 MILK STREET, BOSTON 9, MASS

Please rush UNITRON's Microscope Catalog 37-

Name _____
Company _____
Address _____
City _____ State _____

EQUIPMENT AND SUPPLIES



E—1001. Finishing Media Classifier—Barrel finishing media costs can reportedly be sharply reduced with the new, portable automatic media classifier made by Almco.

Three grades of media can be re-sized automatically at rates of up to 6000 lb per hr. The unit is rolled out, the 10-cubic-foot hopper, loaded and a button pushed. Media can be re-used by re-sizing it in the machine.

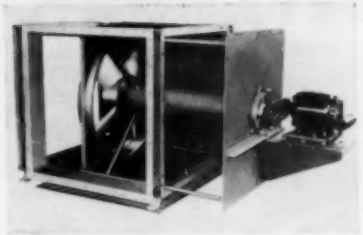
Hoist pans under each screen collect sized media. A large bin at the end of the classifier stores over-size media. Interchangeable screens are available for classifying a complete range of media sizes. Hopper has adjustable metering chute for controlling flow of media into classifier drum. A four-screen classifier is also available.

E—1002. Electrolytic Cleaners—Detrex announces the introduction of a completely new line of electrolytic cleaners for the removal of intentional soils from aluminum and aluminum alloys, zinc, steel, brass, copper, nickel, etc.

They meet high conductivity requirements at lower concentrations without loss in cleaning ability, according to Detrex Chemical Industries, Inc.

The high alkalinity of the new Detrex electrolytic cleaners are said to give maximum saponification when not preceded by other cleaning methods. The soil carrying capacity as well as solution stability have been increased. This prevents the redeposition of soils and insolubles on the freshly cleaned surfaces and makes for easy rinsing.

Existing equipment can be used with these new cleaning processes.



E—1003. Elbow Fans—A new design of elbow fan for general ventilation and for use with such equipment as furnaces, dryers, ovens, kilns, and plating and pickling tanks, has been introduced by L. J. Wing Mfg. Co. Standard units can handle clean or slightly contaminated air or fumes at normal or elevated temperatures. Special construction accommodates corrosive or explosive conditions. Installed in ductwork, the unit occupies only slightly more space than a standard elbow. A choice of three inlet connections is provided.

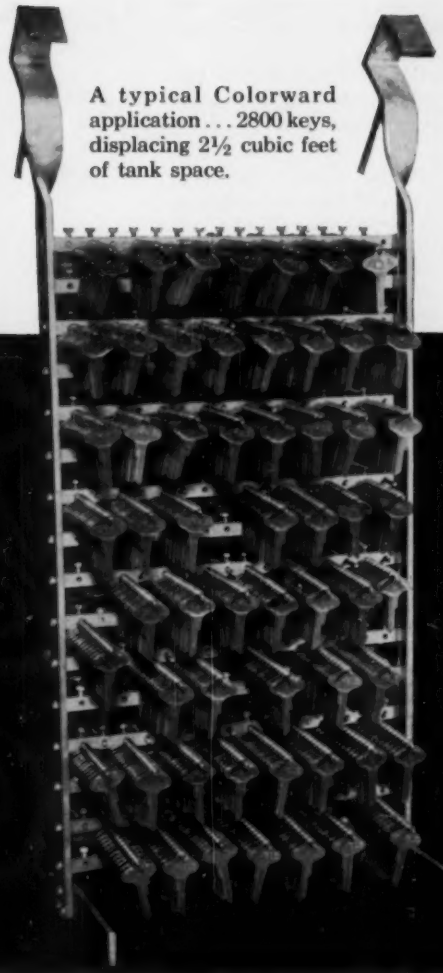
Wingfoil fan wheels have true airfoil blade profiles for high efficiency with

NEW!
defies chemical attack, heat
"in tank" PUMP and outside FILTER
with detachable
FILTER CHAMBER
Model UAL-20 200-300 Gals./Hr.
other models from 50-1200 Gals./Hr.
Compact, takes little space in tank
It's corrosion proof . . . handles all acids and alkaline solutions up to 250°. Self-priming, leakproof EPOXY sump pump provides continuous duty performance. Bracketed inside the tank, it requires no floor space. Outside bracket supports High Temp. Lucite or Epoxy filter chamber . . . ½ or ¾ HP motor. Pump and filter chambers are available separately.
For complete details: WRITE for Spec. Sheet No. 751B
Sethco MANUFACTURING CORP.
NEW Illustrated 8 page Brochure, BULLETIN M-1. Complete catalog of Sethco Filters from 50 to 2700 Gals/Hr.
MAyfair 3-4220 • 2290 Babylon T'p'ke, Merrick, L.I., N.Y.

"A Flexible and Resilient Buff for Flat or Irregular Surfaces"
FORMAX
ZIP-TIP BUFFS
The radial segment construction of the Zip-Tip Buff permits it to perform equally well on flat or contoured surfaces. The cross-cutting movement of the spoke-shaped segments prevent work streaking while it breaks up straight-line patterns on the surface.
- Zip-Tips are available in a wide variety of all cloth constructions —also combinations of cloth and sisal.
- Zip-Tips are made of heavy-duty, bias-cut materials mounted on ventilated steel centers.
- Zip-Tips are extra thick and provide wider buff faces with greater compound retention capacity.
- Zip-Tips are perfectly balanced —require no raking.
Write for Descriptive Literature
FORMAX MFG. CORP.
DETROIT 7, MICHIGAN
"THE FOUR McALEERS"

A REVOLUTIONARY, NEW PROCESS

CUTS PLATING AND ANODIZING COSTS 33% TO 50%



A typical Colorward application . . . 2800 keys, displacing 2½ cubic feet of tank space.

SAVE TIME! SAVE SPACE! SAVE MAN HOURS!

Save money, motion and material with Colorward's revolutionary new work holding process. Now, mass immersion of small objects is possible in remarkably small space, with actual improvement in quality . . . at savings up to 50% over present systems. The patented Colorward process can be licensed on a volume or monthly basis. Our engineers will adapt the Colorward process to your needs and equipment. Your inquiry is invited without obligation.

COLORWARD CORPORATION
4515 SUPERIOR AVE. • CLEVELAND 3, OHIO

COLORWARD CORPORATION • 4515 Superior Ave. Cleveland 3, Ohio

Gentlemen:
We are interested in finding out more about the Colorward process.
Please contact us.

NAME_____

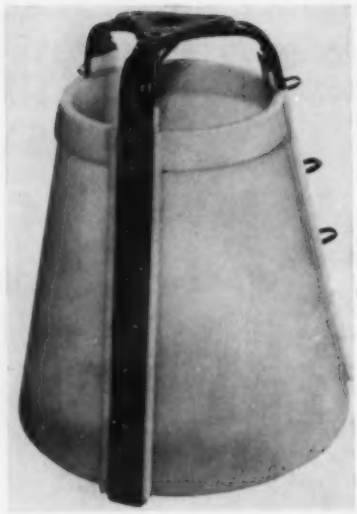
COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE____

minimum turbulence, vibration, and noise. Flat horsepower characteristics prevent motor overload even at full dampered shutoff.

An adjustable-pitch V-belt drive permits field adjustment of capacity to suit actual or changed conditions.



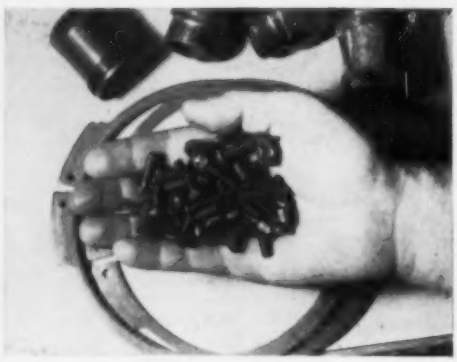
E—1004. Plating Barrel—The metal finishing division of Frederic B. Stevens, Inc., reports the development of a new stronger, lighter and longer lasting plating barrel for use on Stevens Model "C" and "E" automatic plating processing machines. Known as the Stevens Poly-Carb Barrel, this new unit is an addition to the existing line of Stevens plastisol and lucite barrels.

The new barrel claims many advantages such as strong, rigid shape with no 120° angles. There is heavy ring reinforcement at top of barrel to protect against damage while loading. A three-quarter-inch rib completely across bottom adds to rigidity and provides additional support for loading. It also acts as an agitator to help eliminate stratification in heating and cooling as well as replenishing plating solution.

E—1005. Silicon Rectifiers—Rapid Electric announces a new line of silicon rectifiers. The Regal line rectifiers are completely self-contained with starting equiptment, automatic reset thermal overload, push button station, ammeter, voltmeter and shunt.

Magnetic amplifier overload protection provides complete diode protection in 3.5 cycles, the manufacturer states. Balanced diodes, through equalized current distribution transformer design increases unit dependability.

Full wave bridge circuit is claimed to insure less than 5 per cent ripple output.



KENVERT® NO. 11
best olive drab for zinc and cadmium

The General Electric Plant, Industrial Park, Syracuse, uses KENVERT No. 11 because a continuous olive drab film is obtained free of bruise marks on bulk work and connectors. This film absorbs the KENVERT No. 11-B to give a uniform black finish after dyeing.

By switching over to KENVERT No. 11 GE not only improved quality, but also enjoyed a cost reduction and these advantages:

KENVERT No. 11 ADVANTAGES

- Long Life
- Constant color
- Only one product required
- Stable non-varying solution as used
- Excellent corrosion protection
- Easy to dye
- Easy to control
- Available in non-returnable drums
- Meets requirements of government specifications on zinc and cadmium

Specify KENVERT No. 18-M
for economical, iridescent films *also with hard wet film strength* for bulk treating on zinc and cadmium.

WRITE for information and data on "compatible" brighteners for zinc and cadmium for chromate treatments.

CONVERSION CHEMICAL CORPORATION
98 East Main Street, Rockville, Conn., Phone: TRemont 5-3357
Licensee: Nicromatic Ltd., Toronto, Canada
Distributors in major industrial United States cities.

E—1006. Cleanliness Tester—The Model CM-1 cleanliness tester manufactured by Branson Ultrasonic Corp. is reported to make it possible to assign numerical values to surface cleanliness where non-bonded soils are involved.

The machine will measure smut residue after pickling of steel. In addition, the tester may be used to evaluate detergents and oils used on cold mills, annealing furnace performance and efficiency of electrolytic and alkaline cleaning lines.

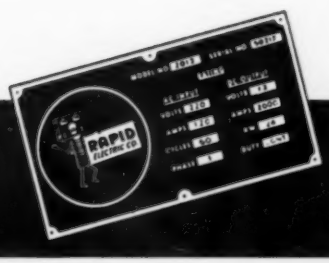
The tester has a linear scale from 0 to 1000. Accuracy of one part in a thousand is claimed to be made possible by a ten-turn potentiometer in the balancing circuit.

E—1007. Chemical Polishing Process—Luster Burr is a new chemical polishing process developed by Alchemize Corp. that levels and brightens the surface of aluminum silicon castings. No electricity or heat required. The process is said to brighten in 10 to 90 sec at room temperature. This new finish is for use prior to anodizing, electroplating, conversion coatings, wheel or barrel finishing, or used as is.

Why not call RAPID'S engineering department with your power requirements. Let us match your requirements with the right type rectifier.

Because each semi-conductor has advantages to offer, and because RAPID supplies *all three*, you can be certain of obtaining sound technical advice.

Call TA 8-2200 for reliable technical service.



THE NAMEPLATE THAT MEANS *"More Power to You!"*

RAPID ELECTRIC COMPANY

12838 Fenkell Avenue • Detroit 27, Mich. • Diamond 1-8537

2881 Middletown Road • New York 61, N. Y. • TAlmadge 8-2200

E—1008. Magnetic Separator—A new, compact, low-cost magnetic separator has been introduced by Techline Division, Wheelabrator Corp.

The new model, No. 3550, separates ferrous parts from media and provides a low-cost answer to those situations in which the size of the part, or holes and recessed areas in the part, make impossible the selection of media that would permit mechanical separation.

In this separator parts and media are carried on a conveyor belt which passes under a cleated, parts-conveyor belt. A permanent magnetic plate located above the parts belt lifts the parts from the media. They are discharged into a media pan or tote box when they reach the end of the magnets.

The non-magnetic media remain on the conveyor belt and are dumped into a separate media pan.

E—1009. Chromate Coating—Amchem Products, Inc., announces the availability of another chemical development, Alodine 1200S, latest addition to its line of amorphous chromate coatings for aluminum.

Alodine 1200S is said to answer one of the most perplexing problems inherent in providing corrosion protection and paint bonding qualities for aluminum by chemical means—the problem of uniform quality.

Incorporating increased chemical activity it reportedly provides up to 50 per cent faster processing, more uniformity of coating, and a higher grade of coating. It is particularly recommended by the manufacturer for use in high production baths such as strip lines.

E—1010. Precisely Made Uniforms—The addition of three new models to its line of women's uniforms has been announced by Worklon, Inc. These include a slacks and blouse combination, a reversible laboratory coat, and an industrial dress, all styled in Dacron. All are claimed to be resistant to grease, oil, paint, and abrasion, as well as to other acids and caustics.

E—1011. Metal Cleaner—Magnus Chemical Co., Inc., has announced a new method for the removal of sodium cyanide salts and quenching oils without the need for hot cyanide solutions. Employing a special, strongly alkaline cleaning compound, Magnus 61-DRX, plus a low-cost, stock agitating-cleaning machine, the Magnus Miji-Lif, the new method offers time and cost cutting advantages.

In one operation, involving the cleaning of steel castings, stampings, screw parts, etc., subsequent to heat treatment in cyanide salts and quenching oil, the combination of 61-DRX and mechanical agitation has cut the cleaning time from two hours to less than 20 minutes, according to the company. The new compound, though strongly caustic, is claimed to be non-fuming and to rinse readily with an ordinary hot water rinse. It reportedly will not cause corrosion if trapped, but will also strip any light corrosion and rust which have accumulated previously.

E—1012. Degreaser—The King Co., Inc., announces a new degreasing machine which is said to combine the advantages of chemical vapor cleaning with the portability and simplicity which other vapor degreasers lack. The introduction of an electrical thermal switch does away with water piping. If any electrical failure should occur in the machine, it is turned off automatically to insure safety.

The portability of this new vapor cleaner has been increased by placing it on 4-in. wheels and furnishing it with a plug-in cord.

Other advantages of this degreaser includes optional circulating spray, simplicity of operation, a special drain plug and angulated plate to simplify solvent recovery.

E—1013. Liquid Level Gauge—An ultrasonic method for continuous and precise measurement of liquid level has been developed by the General Ultrasonics Co. Level is measured continuously in liquid nitrogen, many slurries, thick oils, fused salts, molten metals and many other fluids.

The measuring system is fully transistorized; output is either digital or continuous and adaptable to recording and control, proportioning and blending.

The new Metasonic principle uses solid metal acoustic wave guides to derive its information, essentially ignoring or cancelling the effect of the liquid and its properties on the accuracy of level measurement.

Two Production Tests Show Wearon® BUFF CLOTH up to 48% Better than Competitive Buff Cloths

Test I Bent Copper Tubing for Sink Drain Traps 18" x 7" center—folded segment buff—8 wide folded finger

Unbleached—17,000-18,000 piece average

Wearon—26,000 pieces

Increase—48%

Test II Inside of aluminum street light reflectors—specially built machine. Wearon—31% increase in life over previous buff cloth.

Wearon, Better!! Why? Where? Under what conditions? Wearon BUFF CLOTH is better because it possesses a combination of two outstanding characteristics. The chemical treatment (1) prevents the rapid disintegration of the cotton cloth on jobs involving a high degree of raking or shearing and (2) does not stiffen the cloth. Work of various shapes can pass smoothly through buffs made of Wearon cloth allowing the buffs to mesh into and follow the contours of the object while it remains firmly anchored in the chucks.

Perhaps you would like to check Wearon's cost/performance ratio in your buffing operation? We suggest that you ask your buff supplier to prepare a test lot of buffs made with Wearon cloth in the size and design you need. In this way you can check Wearon yourself to see how it can improve your buffing performance.

Wearon is a trademarked fabric. Together with Types 160, 190 and Redline, it comprises the Milliken line of "Fabrics Engineered for Buffs".

DEERING, MILLIKEN & CO., INC.

1045 SIXTH AVENUE • NEW YORK 18, N.Y.

KANIGEN®

The proved nickel alloy chemical plating—available only from General American and its licensees

KANIGEN is a chemically and metallurgically unique process for applying a hard, corrosion and abrasion resistant surface to most metals. KANIGEN is being used successfully for coating almost everything of any size—from the inside of a tank car to a tiny surgical needle—providing extreme uniformity of coating thickness even on complex shapes. Rack, jig or barrel plating may be used with KANIGEN.

You can rely on General American's integrity and experience and profit from its extensive research and development facilities. KANIGEN, of course, is patented to protect you from imitations.

KANIGEN is a trademark which identifies chemical nickel coating by General American Transportation Corporation and its licensees, the product resulting therefrom and compositions produced by them for use in chemical nickel coating.

KANIGEN is available from General American at East Chicago, Indiana; Sharon, Pennsylvania, and Compton, California, and from licensees in many cities. For further information, call or write.

PHYSICAL PROPERTIES

Specific gravity 7.9
Melting point ..... 1635 °F
Electrical resistivity
approximately 60 micro-ohms/cm/cm²
Coefficient of expansion
13 x 10^{-6} cm/cm per °C or
7.22 x 10^{-6} in/in per °F
Thermal conductivity
approximately 0.0105 to
0.0135 cal/cm sec °C (calculated)
Hardness
as plated—49 Rockwell C
heat treatable to 70 Rockwell C

World's largest production facilities for chemical nickel alloy plating on

Iron
Copper
Aluminum
Titanium
Beryllium
and their alloys

Pilot plant facilities are available for nickel alloy chemical plating on magnesium, uranium and non-metallics including thermosetting plastics, glass, ceramics.

Kanigen Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South LaSalle Street • Chicago 90, Illinois

KANIGEN GENERAL AMERICAN TRADE MARK

THE MODERN, PRACTICAL WAY...
TO HANDLE AND STORE
PLATING MATERIALS

now...a polyethylene drum that resists corrosion...that has uniform wall thickness

Drums from 20 to 55 gallon capacity that safely hold corrosive materials. Molded to insure uniform thickness. Low, low acid permeability. These drums last many times longer than regular steel, yet they're much less costly than stainless. And you save valuable storage space when they're not in use because drums nest in each other. Polyethylene means lighter, easier-to-handle drums in the plant or in transit. They're easy to clean, can be tightly sealed. No other container can give you such efficient, practical service.

REDMANSON
CORPORATION
630 Loucks Mill Road
York, Pennsylvania

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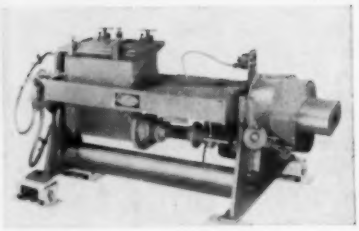
E—1014. Abrasive Belt Machine—A new low-cost model JC abrasive belt finishing machine for performing flat grinding, deburring and polishing operations is now available from Acme Manufacturing Co. The machine is equipped with a six-in. wide abrasive belt and will handle parts having stock thickness up to three in.

It is adapted to abrasive-belt finishing operations on flat surfaces of bars, strips blanks, stampings, forgings, die castings and sand castings. Plastic, ceramic, wood and rubber parts can also be finished on the compact machine.

It has a motorized conveyor belt that carries the work under spring-loaded hold-down rollers and the abrasive belt contact wheel. Multiple head assemblies can be mounted in tandem along one long conveyor belt to perform progressive finishing operations.



E—1015. Vibrator—Lorco Model 1016E, a 3-hp vibrator for precision finishing, is the latest addition to a line that also includes 30-hp, 20-hp and 15-hp vibrators. Employing controlled vibration, these machines are said to work quickly on jobs of cleaning, descaling, deburring, radiusing, fine finishing, coloring, burnishing and ball burnishing. Metal, plastic and wooden parts in a broad range of types, shapes and sizes can be successfully processed.

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Opportunity to Authors

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So as to expedite review and other processing, please write the Editor, PLATING, 445 Broad Street, Newark 2, New Jersey, for full particulars before submitting your manuscript.

Of heavy-duty welded steel construction throughout, the new vibrator has a rubber-lined bowl mounted on special coil and leaf springs. Vibratory action is achieved through the use of an eccentric shaft. The drive speed is continuously variable over a wide range, and a built-in tachometer permits direct reading of frequency. Both frequency and amplitude of vibration can be varied to fit work requirements.

E—1016. Liquid Clarifier Drive—A horizontal spur-gear drive for heavy-duty applications of the Rota-Rake clarifier and thickener has been developed by Graver Water Conditioning Co. It has been designated model C and joins three other drives available with the clarifier, a horizontal flow water and liquid treatment unit for gravity sedimentation and sludge thickening.

The new drive head is a ruggedly constructed, heavy-duty unit with a completely enclosed, integral gearing arrangement. The gears, operating in an oil bath, are of Mechanite cast iron as is the housing. Anti-friction ball and roller tapered bearings are used throughout and the pinions are of forged steel. The model C drive features smooth-running, quiet operation with little wear and minimum maintenance consisting of an infrequent oil change and a regreasing about once every five years, according to Graver.

E—1017. Rinse Additive—Drainage of plated parts is promoted and the number of plating rejects cut down by Hanson-Van Winkle-Munning Rinsoff, a new rinse aid addition agent, according to the company.

Small concentrations added to the hot water rinse will reduce surface tension. Water rinses off fast and water stains are said to be reduced to a minimum.

The additive is a balanced combination of organic active agents and solvents. Two fluid ounces are required per 100 gallons of hot rinse water under normal operation conditions. Additions of up to eight ounces are recommended if water is uncommonly hard or dirty.

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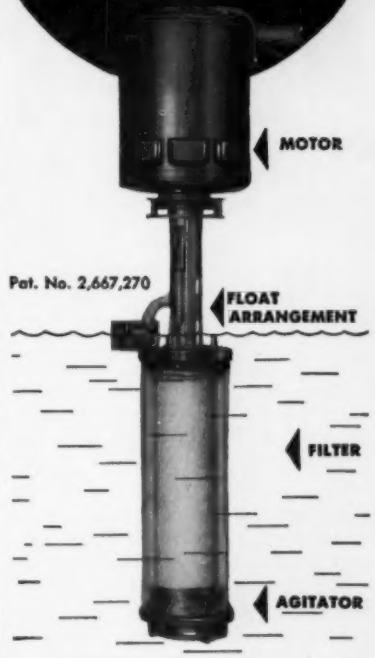

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PERSONALS

H. Schmidt Jr.

S. C. Clements

STANLEY C. CLEMENTS, Chicago, has been appointed director of production engineering for Industrial Filter & Pump Mfg. Co.

With Industrial 12 years, Mr. Clements received his Bachelor of Science in mechanical engineering from Chicago Tech. College.

During World War II, he completed 73 missions with the Air Force in the European Theater—where he won the Distinguished Flying Cross and Air Medal, both with clusters.

HENRY SCHMIDT JR. has been named director of research and development of Industrial Filter & Pump Mfg. Co.

During his five years of service with the company as a development engineer, Mr. Schmidt has been granted a number of U. S. Patents.

He is a graduate of Kings Point Merchant Marine Academy and has served as a lubrication engineer with the American Brass Co., Kenosha, Wis.

CLAY RILEY, Palos Heights, has been appointed director of technical service of Industrial Filter & Pump Mfg. Co.

He received his Bachelor of Science degree in the field of electrical engineering in 1942 from Rose Polytechnic Institute.

Prior to coming with Industrial, he served as plant engineer for Hardy Mfg. Co. in Union City, Indiana, and at Diamond Chain Co., Indianapolis, Indiana as a Maintenance Foreman. His previous post at Industrial was as a research engineer.

●

L. A. DICKINSON has been promoted to the position of managing the newly established East Coast Sales Headquarters of Bee Chemical Co. Mr. Dickinson was formerly at the main office of the firm in Chicago where he devoted several years to both laboratory and sales work on coatings for automotive, appliance and vacuum metalizing applications. His new location will be 119 Ann Street, Hartford 3, Conn.

●

RONALD H. POST has been appointed field representative for the Deering, Milliken & Co., Inc. buff cloth program. Mr. Post's entire business career has been in the textile field, with particular experience in sales and promotional work.

R. H. Post

E. Stanek

EDWARD STANEK, formerly with Belke Mfg. Co. for 17 years, has joined the Process Engineering Co. of Chicago. Simultaneous with this announcement Process Engineering Co. announced that they would be incorporated under their trade name of PRENCO and henceforth will be known as Prenco Engineering Corp.

Mr. Stanek will serve as president of the new corporation and **EDWARD PETERS** will serve as chairman of the board.

Mr. Stanek attended the University of Illinois and the Illinois Institute of Technology and has served in many positions in the American Electroplaters' Society, including the presidency of the Chicago Branch. Mr. Stanek previously was a sales engineer and director of Belke and brings to Prenco a wide experience in the plating equipment field. He will be responsible for sales activities and customer relations, while Mr. Peters, who attended Rensselaer Polytechnic Institute will be responsible for engineering and development.

EUGENE O. EAGLE has been appointed representative for the states of Virginia, North Carolina, and South Carolina. Mr. Eagle is a native of North Carolina and will operate from his home office at 302 S. Tremont Drive, Greensboro, North Carolina.

DOUGLAS H. HOLMES has joined the industrial department of Wyandotte Chemicals Corp. as a sales-service representative in the Kansas City District.

His industrial engineering background includes supervision of metal cleaning and chemical processing in various plants over the past 13 years. As an engineer, Mr. Holmes was in charge of metal finishing and welding operations. At one time he was in business for himself as head of an engineering services firm in the welding-processing field. He is a member of the American Welding Society.

●

RICHARD F. PROTIVA has been promoted to manager of market development, and **ROBERT E. SCHEEL** advanced to manager of national branch sales of Heil Process Equipment Corp., Cleveland.

Mr. Protiva joined Heil as sales engineer in 1940 following his graduation from Case Intitute of Technology with a degree in metallurgical engineering. He became manager of process industry sales in 1956 and Eastern sales manager in 1957. He is a Registered Professional Engineer, and member of the Cleveland Engineering Society.

R. F. Protiva

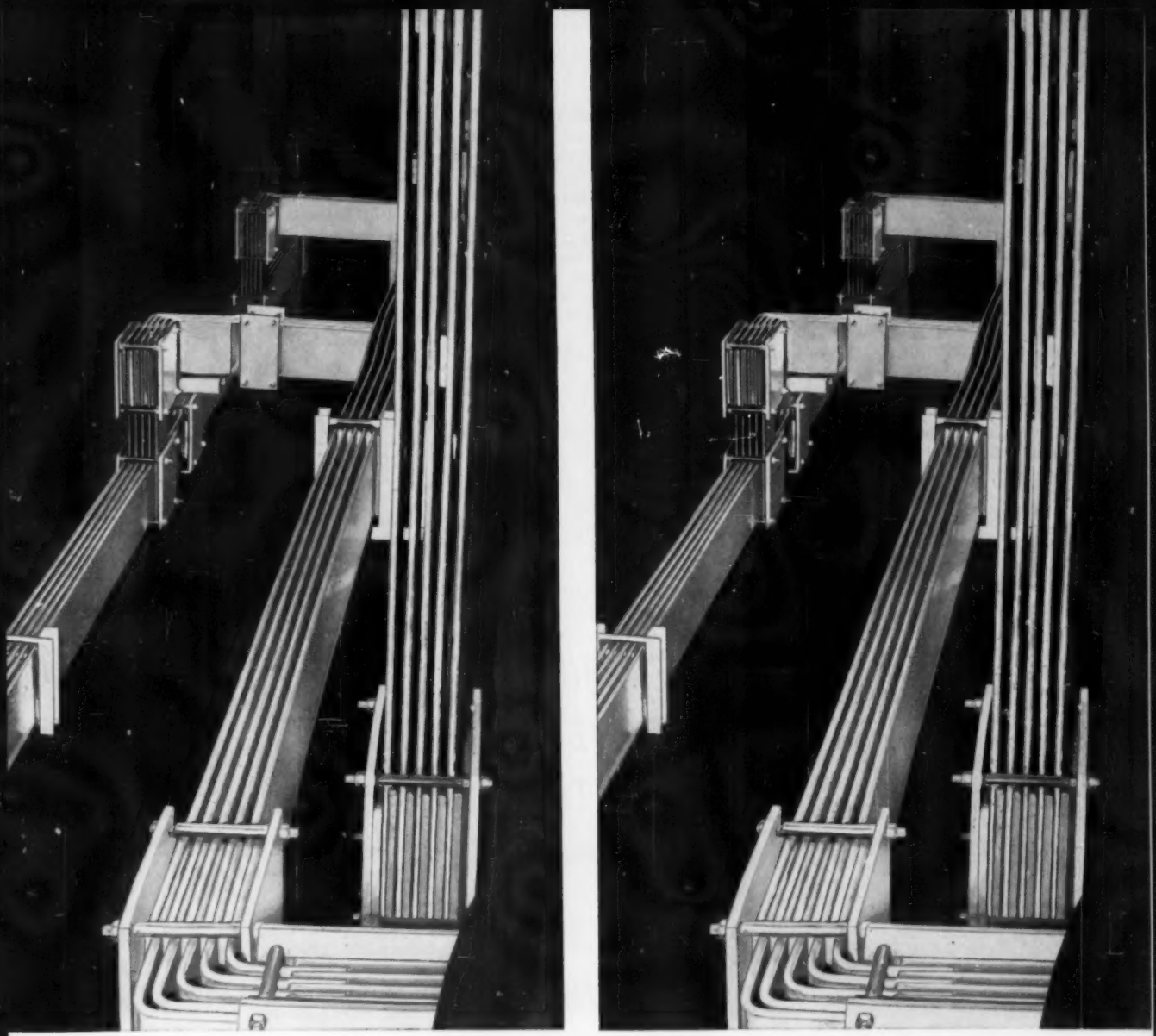
R. E. Scheel

Mr. Scheel joined Heil in 1949 as an estimator, following his graduation from Ohio University. He became sales engineer in 1953, Chicago District Manager in 1955, and Western District Manager in 1958. He is a member of the American Electroplaters' Society.

●

M. JAMES CAMPBELL has been appointed assistant to the vice president of Allied Chemical's Solvay Process Division.

Succeeding Mr. Campbell as manager at Syracuse, Solvay's largest plant, will be **ROBERT B. LAUTNER,** currently manager of Solvay's Moundsville, West



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Virginia operations. **ROBERT E. JAMES** who has been manager of Solvay's Baltimore plant becomes manager at Moundsville. The Baltimore plant will be under the direction of **EDWARD J. WALSH,** assistant manager.

Born in New York City, Mr. Campbell is a graduate of Lehigh University with a degree in chemical engineering. He has been with Solvay since 1939. In his new post Mr. Campbell will be located at Solvay's New York executive office.

Mr. Lautner is a native of Michigan. He is a graduate of Louisiana State University with a degree in mechanical engineering.

A Nebraskan by birth, Mr. James is a graduate of the University of Nebraska with a BS degree in chemistry.

ROBERT E. CLAGETT has been named assistant manager of the Pittsburgh Branch sales office, and **RICHARD A. MARSHALL** made assistant to the manager of the Organic Chemicals Section of Allied Chemical Corp's. Solvay Process Division. In addition, **STUART P. McNEILL** moves from the Philadelphia Branch to New York, where he will assist in carrying out administrative functions of the sales department, and **THEODORE W. REED** is transferred from New York to Solvay's Boston Branch where he will handle sales.

Mr. Clagett, is a native of Dayton, Ohio and a graduate of the University of Cincinnati. He has been with Solvay since December 1952.

Mr. Marshall, a Solvay employe since November 1951 has been with the Boston office since that time. Born in Lexington, Mass., he was educated at Nichols Junior College, Dudley, Mass., Burdett College and Boston University.

Mr. McNeill joined Solvay in 1943 as a clerk, in 1953 was appointed a salesman and assigned to the Philadelphia Branch.

Mr. Reed is a native of Boston and a graduate of Northeastern University with a BS degree in chemical engineering. He joined Solvay's Sales force at Boston in 1950, was transferred to New York in 1956 and in 1958 became assistant to the manager of the Organic Chemicals Section. He returns to Boston to assume increased direct sales responsibility.

●

C. W. HARRS has been named sales engineer, serving the Detroit area for G. S. Blakeslee & Co., Chicago. Mr. Harrs, who has been with Blakeslee about 10 years, has had wide experience in the metal parts cleaning equipment field. He will be operating out of the company's Detroit office at 424 Book Bldg., Detroit 26, Mich.

C. W. Harrs

R. O. Grunditz

ROBERT O. GRUNDITZ has received appointment as sales engineer to serve the Massachusetts area for G. S. Blakeslee & Co., Chicago. Mr. Grunditz has been connected with the metal parts cleaning equipment field for some years. He will be operating out of the company's Massachusetts office at Lechmere Square, East Cambridge 41.

●

ARTHUR H. PARKER has been appointed technical representative for Du Pont sodium products in the Detroit area. Mr. Parker goes to Detroit from Wilmington, where he was chemist at the sales technical laboratory of the company's electrochemicals department. Since joining Du Pont in 1947, he has been engaged in technical work concentrated in the metal treating field.

●

H. W. BUCHANAN has been appointed manager, general sales department, Metal & Thermit Corp. Mr. Buchanan will be responsible for direct selling and distribution components, and will supervise the company's regional managers. Prior to his new assignment, Mr. Buchanan was sales manager for chemicals, metals, and plating products for the company. He joined M & T in 1947 as a chemical engineer. He received the BS degree in

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chemical engineering from Rensselaer Polytechnic Institute, and the MS degree in industrial management from Massachusetts Institute of Technology on a Sloan Fellowship.

He is a member of Society of the Plastics Industry, Society of Plastics Engineers, American Electroplaters' Society, American Chemical Society, and the Chemists' Club.

H. W. Buchanan

W. H. Walczyk,

WALTER H. WALCZYK, formerly chief chemical engineer, Remington Rand Univac—engineering development section—has been appointed Western Sales Representative by Sel-Rex Corp., Nutley, N. J. He will make his headquarters at the firm's Los Angeles office at 11168 Santa Monica Blvd., until arrangements have been completed for larger quarters to house the anticipated expansion of Sel-Rex service to this area.

At Remington Rand Univac, Mr. Walczyk was responsible for the development and installation of facilities for electroplating and finishing printed circuit boards, electronic memory devices and information storage tapes.

Mr. Walczyk was also associated with the specialty electronic components department at General Electric. His 25 years experience includes positions with executive and technical responsibilities with International Harvester and Weedesport Manufacturing Co.

•

WILLIAM J. FISHER has been transferred to the Metropolitan New York and Northern New Jersey territory as a member of the field sales staff of the Vacuum Equipment Division of F. J. Stokes Corp., Philadelphia. He has been manager of Stokes' sales office in Atlanta, Georgia, for the past two years.

A native of Hartford, Conn., Mr. Fisher served for five years in the U. S. Air Force as a navigator and bombardier. Following five years of industrial sales and sales management experience, he joined Stokes in June, 1956, as a salesman in the Philadelphia district office. He was placed in charge of the Atlanta office when it was opened early in 1957. The Stokes district office for the Metropolitan New York and Northern New Jersey area is at 2165 Morris Avenue, Union, N. J.

•

EDWARD B. PSYCK has been named technical representative for Eastern and Central New York State by the Frederick Gumm Chemical Co. Inc. Mr. Psyck's office will be located at 500 Park Avenue in Syracuse, N. Y.

He has twenty years of experience in the metal finishing field. Previous to joining Gumm, he was associated with Electric Auto-Lite Co., Syracuse, where he was in charge of all metal finishing operations. He has also been associated with Easy Washer Machine Co., Syracuse, and Brown-Lipe-Chapin, Division of General Motors. Mr. Psyck is an officer of the AES, Syracuse Branch, and a member of the American Society for Metals, and the New York Sewage and Industrial Wastes Association.

DAVID C. JOHNSON has joined Enthone, Inc. of New Haven, Connecticut, subsidiary of American Smelting and Refining Co., as a chemist in the Enthonics Laboratories. Mr. Johnson graduated in June from Principia College, Elsah, Illinois, where he majored in chemistry. At Enthone, he will work on both research and technical service projects.

E. B. Psyck

D. C. Johnson

WILLIAM W. PEDERSEN, manager of the Dow Corning Corp., Cleveland sales office, is being transferred to the main office, Midland, Michigan. Mr. Pedersen becomes a full-time member of a new corporate planning committee reporting to the president.

MAX H. LEAVENWORTH, now manager of the Southwestern branch in Dallas, will become manager of the Cleveland office. **EDWIN HAIRE** of the Dallas office will succeed Mr. Leavenworth as manager.

Mr. Pedersen, 43 years old, received his BS and MS in chemical engineering from the University of Louisville and is a member of the American Chemical Society.

Mr. Leavenworth was born in Clio, Michigan, in 1915 and received a BS degree

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from Eastern Michigan University. After considerable teaching experience, he joined Dow Corning in 1945.

Mr. Haire, 44 years old, is a native of Howell, Michigan. At Western Michigan University, where he received his BS degree in 1939. During the war he was radar and navigation officer on a destroyer. In 1951 he received his masters degree from Wayne State University. He was associate professor of mathematics at Lawrence Institute of Technology in Detroit before joining Dow Corning in 1952.

•

WILLIAM B. STODDARD JR. has been promoted to manager of electrochemical development at Hanson-Van Winkle-Munning Co. Formerly, Mr. Stoddard was assistant manager of the department.

Mr. Stoddard, a University of Colorado graduate with a BA in chemistry, joined H-VW-M in 1957. Prior to that time he had worked for a variety of companies both here and abroad.

From 1936 through 1939, he was in charge of a research laboratory at a large automobile plant abroad. During the war years, 1939 through 1950, he was a group leader with the research and development department of the Champion Paper and Fibre Co. For part of this time he was on loan to the Kellex Corp. in charge of research laboratories for the Manhatten Project.

From 1950 through 1957, he was a consulting chemist, specializing in patent, plating and transducer development. He received his MS from Texas A&M in 1952 in oceanography.

Mr. Stoddard is a member of The Institute of Chemists, The American Chemical Society, American Society for Metals, The American Electroplaters' Society, The Electrochemical Society, and The American Association for the Advancement of Science.

He is a frequent contributor to foreign and domestic technical journals and holds a number of patents.

•

R. E. SHEPARD has been promoted and **W. E. DOWNEY** transferred in Electrochemicals Division, Technical Service Group of Diamond Alkali Co.

At his new post Mr. Shepard will assume responsibilities as a field technical service man. Previously, he worked in the plant control laboratories as well as various research laboratories. He has been with Diamond since 1940.

A veteran, he attended Ohio University, Athens, O., and Case Institute of Technology.

W. E. Downey transfers to the vacancy created by Mr. Shepard in the Technical Service Group. He has been with Diamond since 1956, when he graduated from Otterbein College, Westerville, O., with a BS degree in mathematics and chemistry.

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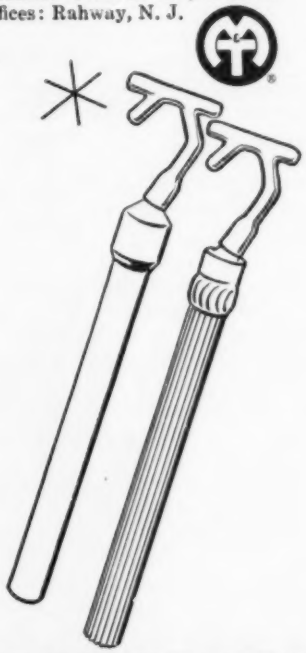

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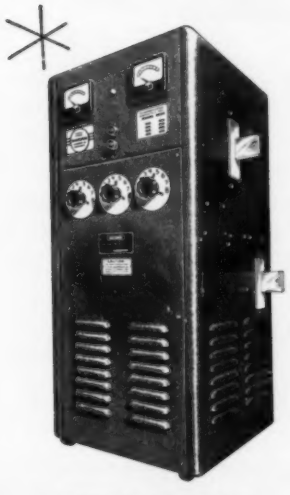

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BOOKS

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Coatings for Protecting Molybdenum from Oxidation at Elevated Temperature by E. S. Bartlett, H. R. Ogden and R. I. Jaffee, Defense Metals Information Center, Battelle Memorial Institute for Office of the Director of Defense Research and Engineering. Mar. 1959. 45 pages. (Order PB 151064 direct from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., $1.25).

Advantages and disadvantages of coatings developed to protect molybdenum from oxidation in high temperature applications are compared to aid in selecting the coating or combination of coatings most suitable for a particular application. The protective coatings are presented from two points of view—the coating systems and the methods of application. Chromium, silicon, nickel, precious metals, ceramic materials, and refractory oxides are among the systems discussed. Methods of application include electroplating, flame spraying, vapor disposition, cladding, enameling, and liquid-phase diffusion. Tables concerning probable coating requirements for molybdenum in various types of service at high temperatures are provided.

Research for Coatings for Protection of Niobium Against Oxidation at Elevated Temperatures by E. C. Hirakis, Horizons Incorporated for Wright Air Development Center, U. S. Air Force. Feb. 1959. 74 pages. (Order PB 151684 direct from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. $2.)

The oxidation rate of niobium at 2000F was reduced by a factor of 20 by additions of cerium, chromium, titanium, and aluminum. In addition, flame spraying and electrodeposited coatings were developed which give niobium 4 to 6 hours protection at 2500F. These efforts to protect niobium against oxidation by alloying and by metallizing or electroplating resulted in the fabrication of test pieces which reportedly show promise and demonstrate the feasibility of the methods employed. Although the arc-melted alloy was superior to pure niobium in oxidation resistance, the degree of improvement fell far short of the factor of 100 which is generally agreed to be the prerequisite for niobium base materials at 2000F. Specimens produced by the two coating methods equalled or surpassed the minimum standard. However, in their present state of development, both coatings are termed unreliable due to difficulties encountered in reproducing the test results. Preparations, test procedures, and results are described for both the alloy development and coating work.

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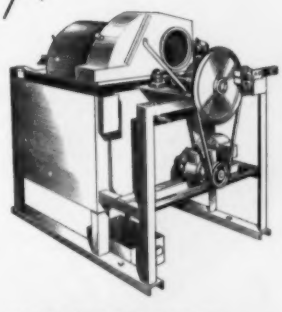

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BRANCH NEWS

Total AES Branches U. S., Canada, Australia, October 1, 1959—58.

DETROIT

Executive Committee Meets; Annual Meeting December 4

On Friday evening, August 7 **Donald M. Bigge,** Detroit Branch president, called a special executive meeting. It was held at the Statler-Hilton Hotel.

Clarence DeGroat of the J. J. Siefen Co. was announced as the new assistant secretary-treasurer to succeed **John Hitchcock** of DuPont, who has been transferred to Wilmington. **Arnold Emmerich** of Siefen Compounds, Inc. replaced Mr. Hitchcock in the capacity of Stag Day chairman.

It was announced that **Kurt MacKenzie** died in Florida recently.

Lee Morse, Chrysler Corp., 1959 Christmas Party chairman, recommended the same procedure be followed this year as at the last party. Program Chairman **Vincent Cassidy** announced the speakers and programs for the meetings of the balance of 1959. William Anderson of Frederic B. Stevens, Inc., was appointed publicity chairman for 1959–60. The Annual Meeting-National Officers Night will be held on December 4 with a Symposium on Nickel Plating.

R. C. Trees
Publicity Chairman

EDITOR
PLATING

On behalf of the Ladies Auxiliary, Detroit Branch AES would like to say thank you to all who made our work so enjoyable. To the Ladies who thanked us so profusely and told us what a terrific time they had, all we can say in return is that we had fun doing it.

As our president, Sylvia Cummings, told you on the *Aquamara*, we were having a ball at our own party, so "Gals" you don't know what fun you are missing if you don't have an Auxiliary.

If any of you are in Detroit on our meeting nights, we would be delighted to have you join us. We meet the first Friday of the month, (October 1959 the exception, that meeting will be Tuesday, Oct. 6) at the Statler, we are generally in the lobby by six o'clock as we have more fun having dinner together.

Would like to thank PLATING MAGAZINE's reporter Frances Hoffman for the wonderful digest of the Ladies program for which we, the Auxiliary, are very grateful to the generous sponsors who made the parties possible. A commendatory is due, in fact, to all who worked so tirelessly to make AES's Golder Jubilee one which will never be forgotten and which we feel will never be surpassed.

It was real nice meeting Mrs. Scott, hostess of the Oakite Party, at the National Airport, Washington, D.C. and Mrs. Lowry who worked on registrations. Had quite a chat with Mrs. Moreau of Montreal, Canada. Of course, we hashed over the Montreal Convention and agreed the Laurentian Trip was the highlight.

Hope you all enjoyed our chairman, Alice Pillsbury of Pillsbury Chemicals, to us Alice in Wonderland or a "Fairy Queen", she just seemed to pull things out of a hat, on Doe Day she thrilled and surprised us when she asked Betty McAleer, our past president, and Sylvia Cummings, the president, to come forward and then presented them with an "Auxiliary Gavel", engraved "Ladies Auxiliary, Detroit Branch AES."

While the men were having fun on Detroit Branch's recent Stag Day, like little boys have to do once in a while, we the Gals, were having a wonderful time at our second "Annual Doe Day", at Bob and Martha Dudley's spacious estate in Birmingham. You know Bob is the fellow who roasted the "Ox" at the Artillery Armory Grounds and served all the delicious food and coffee etc., *late, late* Thursday night after the banquet. We were all happy to have Marge Pinner come from Cleveland, Ohio to join in our fun. Marge is the wife of Walter Pinner, who worked so hard on "technical papers" for the Convention.

Now to you men who receive PLATING at your office, won't you please take it home so your wife can read it, or better still have it mailed to your home. I find it quite interesting, maybe your wife will, too. You will be surprised to find out how much it helps you keep closer to the friends you see only once in awhile.

Edna Heavens
Magazine Publicity Chairman
Ladies Auxiliary
Detroit Branch, AES

NEWARK

Enjoy Visit to Ballantine's

Over 50 enthusiastic members of the Newark Branch turned out for a visit to the Ballantine Brewery on June 25. At the conclusion of the tour and after an appropriate time spent pleasantly sampling the plant's product, a short business meeting was called by President **Meyer.**

BRANCH SECRETARIES

Branch News is required of all Secretaries monthly by AES Bylaws. First of the month is Branch News deadline for next PLATING issue. Any items on hand on that date will be carried in that edition. Later arrivals will appear in the issue immediately following. In reporting talks given by speakers before the Branch, please give titles of the talks, the speakers' full identification and any other pertinent information of interest to other Branches and PLATING's broad readership.

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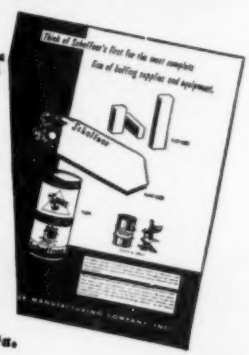

SCHAFFNER MFG. CO. Dept. P-10, 21 Herron Ave., Pittsburgh, Pa.

It was moved and passed that the Branch dues be raised to $12 to absorb the per capita tax increase voted at the AES Convention in Detroit.

Seven men were elected to membership.

D. Gardner Foulke
Secretary

SEATTLE-PUGET SOUND
Gorton and Mosher Give Convention Impressions

The June meeting of the Seattle-Puget Sound Branch was held at Andy's Diner, 2963 4th Avenue South on June 30.

The program was to include election of officers, and a report of the delegates to the convention. As not enough members were present to make a quorum the election of officers was delayed until the September meeting.

None of the accredited delegates were present so **Tom Gorton** of Boeing Airplane Co. and **Art Mosher** of the Naval Torpedo Station, Keyport, Washington gave their impressions of and thoughts on the convention. Both men spoke of the language problem encountered due to the large number of foreign visitors.

Helen Archibald
Secretary

AES MEMBERSHIP REPORT

ELECTIONS

Dallas-Ft. Worth: T. M. Anderson, G. S. Bentinck R. W. Payne, T. M. Smith
Denver: W. T. Samuelson
Hartford: E. Krom
Newark: L. R. Albert Jr., R. C. Brumberger, W. E. Duggins, C. I. Knecht Jr., H. B. Koehler, S. Ludsin, H. S. Schoen
Pittsburgh: C. H. Walton
Southern Tier: C. Pettus
Toledo: F. D. Rogers, G. R. Weaks
Member-at-Large: D. B. Orden, Mexico D. F., Mexico; R. K. Robinson, Magnolia, Arkansas

REINSTATEMENTS

Newark: R. Litterio
Philadelphia: N. G. Wallace

TRANSFERS

Bridgeport: E. Gossman to New Haven
Cincinnati: J. DeLuca to Pittsburgh
Dallas-Ft. Worth: R. F. Walton from Newark
Detroit: R. G. Counselman to Dayton, J. D. Patrick from Waterbury, F. E. Revell from Twin City, J. I. Vlossak to Milwaukee
Hartford: B. C. Salmonsen to Miami
New York: E. Saubestre to New Haven
Philadelphia: N. G. Wallace to Los Angeles
Pittsburgh: J. DeLuca from Cincinnati, J. R. Haines to Cleveland, L. N. McOmber to Toledo, R. C. Smith from Clevela.ad
Southeastern: J. S. Linn to Miami, R. G. Tuttle to Blue Ridge
Toledo: L. W. McOmber from Pittsburgh
Waterbury: F. T. Eddy to Los Angeles, J. D. Patrick to Detroit
Member-at-Large: F. R. Martin Jr. from Twin City, W. P. Wisdom from San Antonio

RESIGNATIONS

Chicago: C. F. Finkler, G. P. Glab, L. M. Glassner, H. F. Hansen, L. J. Kocour
Detroit: C. R. Beaubien, H. E. Moser
Hartford: J. Madzik
Louisville: D. L. Grover, S. L. Harris, P. Trifiletti
New York: H. Stahel
Philadelphia: P. W. Schuler
Pittsburgh: C. Galba, J. W. Kerstetter, M. G. Leech, A. S. Mickelson, F. W. Mountain, G. E. Wolfe
Syracuse: G. A. Brost
Twin City: C. J. Ahlgren, M. A. Armstrong, J. H. Batten, R. Beatty, W. M. Bloomquist, R. A. Bowman, R. L. Buckley, S. S. Cady, G. Cantin, L. J. Cerrotta, E. Christe, E. G. Cleare, G. Deedon, M. I. Doebler, D. F. Drogue, L. B. Ebner, W. W. Edwards, J. R. Ehnes, C. Emme, R. Ertl, P. Felt, H. A. Fischer, J. Flekke, E. R. Frost, W. Ganschinietz, T. L. Garvey, E. V. Gillaspy F. E. Guertin, J. J. Harrington, G. L. Hendrickson, P. R. Hesse, E. Holzem, R. P. Hood, W. A. Huntley, F. Ireland, A. J. Johnson, H. B. Johnson, W. W. Johnson, H. C. Jorgensen, A. Joyner Jr., O. Joyner, F. J. Kaim, F. H. Kilpatrick, H. R. Kittleson, C. Kupelian, R. H. Lamb, A. G. Levine, C. Lewis, E. H. Lindemann, H. Lund, J. Lynard, B. J. Marben, E. McMonagle, C. E. Mertensotto, B. L. Miller, J. A. Mitchell, G. T. Murphy, H. K. Norman, B. J. Olson, R. H. Peterson, C. G. Platt, G. Reed, V. Rosenblum, B. J. Rosenthal, R. Rossa, F. J. Sains, W. R. Schaaf, G. Schedin, W. E. Sebatka, D. Smith, H. A. Sprandel, W. C. Sverkerson, R. J. Tepley, R. Venier, F. E. Walsh, P. Werner, A. E. Wendell, A. Wolkerstorfer, E. L. Young, J. M. Zangs Jr., G. R. Zimmerman
Member-at-Large: K. E. Langford, Birmingham, England, J. C. Stratton, Newton, Connecticut

SUSPENSIONS

Allentown-Reading: W. J. Jancik, G. J. Oswald, E. E. Snyder, R. Southworth, L. C. Wotring
Capitol District: L. Hibbs
Chicago: D. R. Arendt, S. G. Balinski D. M. Berlin, E. W. Berrenkotter, C. E. Brakenridge, J. S. Brown, L. L. Brown, A. A. Comyn, H. E. Delevitt, L. Duncan, E. L. Faulman, E. I. Harrison, E. R. Kopcinski, J. Kopcinski, W. Lopotko, J. S. Parker, G. E. Tucker
Cleveland: E. E. Chrisman Jr., R. C. Smith
Columbus: R. A. Benson, D. E. Semons
Dallas-Ft. Worth: R. V. Barrett, W. S. Gustafson, J. J. Phillips, A. Rotoli
Denver: O. T. Towner
Grand Rapids: R. D. Gray Jr., W. L. Guiltinan, M. F. Haehnel Jr., A. J. Jackson, F. J. Maes, W. J. Van Dyke
Lancaster: J. E. Biemiller
Melbourne: T. W. Brown, C. O. Johnston,
Milwaukee: E. A. Warnecke
Mississippi Valley: C. Bailey Jr., P. Glaudel E. Schnittgrund, R. L. Stoneking
Newark: C. Ivins
New Haven: L. Brown, L. J. Goldfarb, A. G. Jagun, L. M. Migliernis, J. A. Mitchell, R. M. Sasso, L. L. Young
Pittsburgh: C. W. Churchill, G. C. Gardner, A. Hart, R. R. Hartung, A. J. Jantsch, R. K. Mathews, J. Presto, P. W. Rhodes, L. Schmitt Jr., P. G. Sellger, A. Schowalter, J. Tucker, R. Smith, C. F. Stevens, A. E. Weber
Portland: W. Bornett, W. A. Doney, J. M. Hogl, A. Wood
Saginaw Valley: W. J. Brown, H. L. Duley, C. E. Kimmel, G. R. Packer, E. C. Swift
St. Joe Valley: C. K. Bock, J. R. Curtiss, O. Fager, G. H. Fetherston, W. F. Fletcher, J. M. Hedges, C. Jodon, J. B. Kimble, R. H. Kindig, P. Moore, C. E. Prough, H. T. Reece, J. E. Russ, C. Rzepko, L. Waite, R. W. Welch
St. Louis: E. Martin
San Francisco: E. R. Dodge
Southern Tier: K. J. Ashley, M. J. Capece, J. E Darling, J. Majka, F. A. Smith
Sydney: R. E. Brown
Syracuse: D. J. Costello, R. E. David, I. P. Lynch

DEATHS

Bridgeport: M. J. Brassard
Cincinnati: J. Bruewer
New York: J. F. Davis

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FUTURE MEETINGS

AMERICAN ELECTROPLATERS' SOCIETY

November 7, 1959—**First Midwest Regional Conference,** All Day, Rockford College, Rockford, Ill. Sponsored by AES Midwest Regional Council.

December 4, 1959—**Detroit Branch,** Annual Meeting—National Officers Night—Symposium on Nickel Plating, Statler-Hilton Hotel, Detroit, Mich.

December 8-9, 1959—**Dallas-Fort Worth Branch,** co-sponsored with the Southwest Society of Aircraft Materials and Process Engineers, Symposium on "Treatments and Finishes for Aerospace Materials," Hotel Texas, Fort Worth, Texas.

January 15-16, 1960—**Second Annual Dixie Regional Technical Session,** Saxony Hotel, Miami Beach, Florida. Sponsored by Miami Branch with Blue Ridge and Southeastern participating.

January 23, 1960—**Grand Rapids Branch,** Annual Educational Session and Dinner Dance, Pantlind Hotel, Grand Rapids Mich.

January 30, 1960—**Chicago Branch,** Annual Meeting and Banquet, Conrad Hilton Hotel, Chicago, Ill.

February 19-20, 1960—**Seventh Interim Meeting,** Philadelphia Host Branch, and Golden Anniversary Educational Meeting and Banquet of Philadelphia Branch, Ben Franklin Hotel, Philadelphia, Pa.

April 23, 1960—**Sixth Tri-State Regional Meeting,** Cincinnati Host Branch, Sheraton-Gibson Hotel, Cincinnati, Ohio.

April 23, 1960—**Twenty-First Annual New England Regional Meeting,** Bridgeport Host Branch, Hotel Statler, Hartford, Conn.

April 29-30, 1960—**Sixth Empire State Regional,** Southern Tier Host Branch, Mark Twain Hotel, Elmira, N. Y.

July 24-28, 1960—**47th AES Annual Convention,** Hotel Statler, Los Angeles, Calif.

June 18-23, 1961—**48th AES Annual Convention,** Hotel Statler, Boston, Mass.

June 25-28, 1962—**49th AES Annual Convention,** Schroeder Hotel, Milwaukee, Wis. Sponsorship Midwest Regional Council.

June 24-27, 1963—**50th AES Annual Convention,** Ambassador Hotel, Atlantic City, N. J. Sponsorship Newark Branch.

June 21-25, 1964—**51st AES Annual Convention,** St. Louis, Missouri

INTERSOCIETY

October 18-22, 1959—**The Electrochemical Society,** Fall Meeting, Deshler-Hilton Hotel, Columbus, Ohio.

October 21-24, 1959—**Federation of Paint and Varnish Production Clubs 37th Annual Meeting and 24th Paint Industries Show,** Convention Hall, Atlantic City, N. J.

November 2-6, 1959—**41st National Metal Exposition & Congress,** International Amphitheatre, Chicago, Ill.

November 5-7, 1959—**American Chemical Society,** Southeastern Regional Meeting, Symposium on Corrosion of Iron and Tin, Hotel John Marshall, Richmond, Virginia.

Nov. 30-Dec. 4, 1959—**27th Exposition of Chemical Industries,** New York Coliseum, New York City.

January 12-15, 1960—**Society of Plastics Engineers**—16th Annual Technical Conference, Conrad Hilton Hotel, Chicago, Ill.

January 26-27, 1960—**Society of Vacuum Coaters** Third Annual Meeting, Hotel Biltmore, New York City.

February 1-5, 1960—**American Society for Testing Materials,** Committee Week, Sherman Hotel, Chicago, Ill.

February 1-5, 1960—**Instrument Society of America,** Instrument-Automation Conference and Exhibit, Houston Coliseum, Houston, Texas.

March 9-11, 1960—**Instrument Society of America,** Temperature Measurement Symposium, Deshler-Hilton Hotel, Columbus, Ohio.

May 1-5, 1960—**The Electrochemical Society,** Spring Meeting, LaSalle Hotel, Chicago, Ill.

May 9-13, 1960—**American Society for Metals,** 2nd Southwestern Metal Exposition and Congress, State Fair Park, Automobile Building, Dallas, Texas

June 26-July 1, 1960—**American Society for Testing Materials,** 63rd Annual Meeting (with Apparatus Exhibit), Chalfonte-Haddon Hall, Atlantic City, N. J.

July 24-26, 1960—**National Association of Metal Finishers,** 5th Anniversary and Membership Meeting, Hotel Statler, Los Angeles, California.

July 25-26, 1960—**National Association of Metal Finishers,** 5th Anniversary Management Seminar, Hotel Statler, Los Angeles, California.

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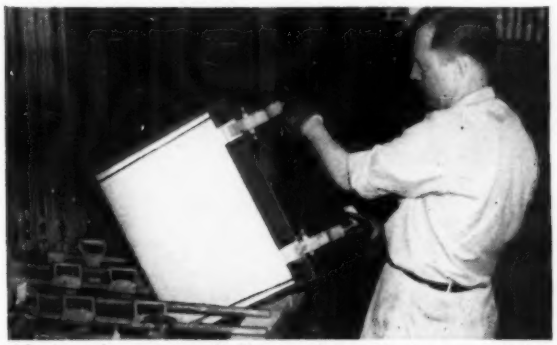

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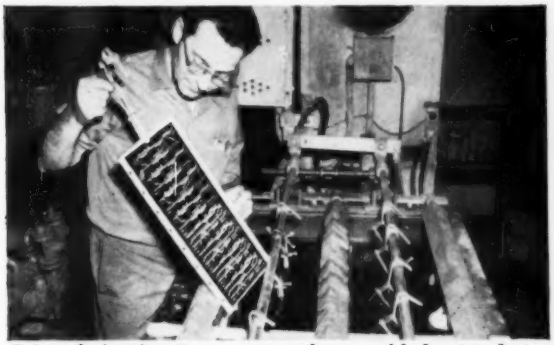

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